Industrial Development Subsidiary Agreement

THE B.C. TECHNOLOGY CENTRE REPORT

June 1984

Research Report

Province of British Columbia
Ministry of Industry and Small Business Development

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Regional Industrial Expansion
Expansion Industrielle Régionale

THE B.C. TECHNOLOGY CENTRE REPORT

June 1984

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The responsibility for the content of this report is the consultant's alone, and the conclusions reached herein do not necessarily reflect the opinions of those who assisted during the course of the investigation or the Federal and Provincial Governments which funded the study.

TABLE OF CONTENTS

I. **An EXECUTIVE SUMMARY of the Study and its Recommendations**

II. **The Task Force Report on the Establishment of:**

"PRODUCTIVITY & INNOVATION INCORPORATED"

Page

1. **INTRODUCTION**
   - a) Background
   - b) Terms of Reference 1

2. **STUDY APPROACH** 3
   - a) The British Columbia Focus 3
   - b) Methodology 4
     - i) Market Research 5
     - ii) Opportunity Analysis 5
     - iii) Structural & Organizational Analysis 6
     - iv) Financial Analysis 7

3. **COMPETITIVENESS & NEW TECHNOLOGIES** 8
   - a) An Industrial and Economic Profile 8
     - i) The Global Context 8
     - ii) The National Context 10
     - iii) British Columbia 12
   - b) The Importance of New Technology to Industrial Competitiveness 17
   - c) The Productivity Challenge 20
     - i) Accepting the Challenge 20
     - ii) International Competition 21
     - iii) The Japanese Standards 23
     - iv) A Practical Approach 25

TABLE OF CONTENTS

		Page
4.	**B.C. INDUSTRY SURVEY FINDINGS**	26
	a) Summary of Key Findings	26
	i) Mechanical Manufacturing	28
	ii) Electrical & Electronic Manufacturing	29
	iii) Resource Industries	30
	iv) Professional Services	31
	b) Industry Survey Conclusions	32
	i) The Concensus of Local Industry	32
	ii) Identification of Productivity Opportunities	33
	iii) Business Information and Management Systems	34
	iv) Product Development	35
	v) Production Hardware and Related Systems	36
	vi) Effectiveness of Human Resources	37
5.	**OPPORTUNITIES IN B.C.**	39
	a) Established Resources & Facilities in B.C.	39
	i) Community Colleges	39
	ii) Universities	42
	iii) Research Facilities	44
	iv) Government Programs	44
	v) Other Resources	45
	b) New National Initiatives	46
	i) Canadian Labour Market & Productivity Centre	46
	ii) The Institute for Manufacturing Technology	48
	iii) Canada's Rail Expansion Program	49
	c) Resource and Transportation Industries	51
6.	**A PRODUCTIVITY & INNOVATION CENTRE IN B.C.**	54
	a) The Concept Behind Existing Technology Centres	54
	b) Some Examples to Build On	56
	c) The Mission of a Centre in B.C.	58
	d) Measurement of Success	59
	e) Services to be Provided	60
	i) Business Analysis and Opportunity Identification	62
	ii) Business Resource Productivity	63
	iii) Quality & Reliability	63
	iv) Product Development Services	64
	v) Human Resource Effectiveness	65
	vi) Information Services	66

TABLE OF CONTENTS

		Page
7.	**CONCLUSIONS & RECOMMENDATIONS**	68
a)	Organization of the Centre	68
i)	The Corporate Structure	68
ii)	The Board of Directors	69
iii)	Staffing and Organization	70
iv)	Senior Management	73
v)	Industry and Labour Working Committees	74
vi)	Planning to Establish the Centre	74
b)	Funding Requirements & Budget Outline	76
i)	Capital & Equipment	76
ii)	Staff Resources	79
iii)	General Operating Expenses	80
iv)	Revenue Potential	81
v)	Funding Requirements	82

APPENDICES

A. RESEARCH INFORMATION

i) Established Resources & Facilities in B.C.
   - Unversities, Colleges & Technical Institutes
   - Government Programs & Agencies
   - Private Sector Service Organizations
   - Sources of Private Sector Capital

ii) Contacts Interviewed from Canadian CAD/CAM Advancement Council

iii) Other Canadian Centres Contacted

B. B.C. STUDY BACKGROUND MATERIAL

i) The Study Team

ii) The Executive Advisory Committee for the Study

iii) General Questionnaire

C. BIBLIOGRAPHY

i) Detailed Business Plans

ii) Seminars and Conferences

iii) Other Studies and Reports

THE B.C. TECHNOLOGY CENTRE REPORT
EMPHASIZING PRODUCTIVITY & INNOVATION SERVICES

"Productivity & Innovation Incorporated"

I. An EXECUTIVE SUMMARY of the Study and its Recommendations

The B.C. Technology Centre Report was produced for the Executive Advisory Committee of the Western Foundation For Advanced Industrial Technology. The study was funded through a grant from the Governments of Canada and British Columbia under the Industrial Development Subsidary Agreements. The mandate of the study was to examine the feasibility and make recommendations concerning the establishment of a technology centre in B.C. The study included market, opportunity, financial, structural and organizational research and analysis.

After an examination of existing technology centres, particularly involving those already established in other provinces in Canada, and following an analysis of the market research findings, the study team and the Executive Advisory Committee have recommended that a centre be established in B.C. with a focus on productivity issues and to provide business services which will assist in developing volume growth as well as planning, technical and training services related to the application of appropriate computer-based technologies. The primary client group for this centre should be the senior executives and managers of medium and small businesses.

It is the senior executives and managers who need to know how new technologies affect their company's market and how technology can be applied in their business to increase competitiveness and profitability. The market research revealed that few executives had been directly exposed to these technologies and even less had a clear understanding of the role they should personally take in assessing and implementing technological change in their companies.

While lack of awareness, planning and technical expertise are barriers to applying new technologies, another substantial barrier in B.C. arises from current poor production volumes and underutilized capacity. There is need to

identify and search out new markets for volume replacement and growth. The incentive and ability to afford investments in new technologies, is directly related to volume growth and the ability to free up capital through more efficient and productive operations.

It is the opinion of the study team and the Executive Advisory Committee that existing technology centres have a tendency to be "engineering driven" and to be technology advocates with an engineering client group. The key issue in B.C. is not so much the delivery of technical and engineering services, as proper orientation, focus and identification of the most effective method to encourage the growth and competitiveness of medium-sized and small businesses in B.C.

To accomplish this the centre must focus on serving the needs of owner managers and senior executives related to productivity issues. The application of new technologies can be an effective strategy to improve productivity, but should only be implemented after decision-makers have established strategies and business plans reflecting corporate growth goals.

The investment in new productivity improving technologies is an issue of corporate leadership and committment to the planned growth and profitability of the firm. An executive management orientation would facilitate market entry for the centre into a range of market research, technical engineering and training services, associated with meeting productivity and growth goals of companies.

Tied to this productivity focus are innovation services. Economic growth and employment creation in B.C. will be linked to a more competitive and productive resource sector. The medium and small business community in B.C., which to a large extent depends on the resource sector as a market, must respond to the productivity needs of resource companies by producing higher quality goods and services at lower prices, and develop new products to enhance the productivity of resource companies. In addition, to survive and grow, the medium and small business community must be encouraged to design and develop new products for international as well as domestic consumption.

A major recommendation of the study team and the Executive Advisory Committee is that the proposed centre perform a clearing house and referral service for existing public and private organizations offering information, technical services and training programs in the application of new technologies as they affect medium and small businesses.

The centre should not duplicate or compete with already existing public and private sector service facilities. The existing service mix of technical abilities and equipment includes universities, colleges, research organizations, government programs, private labs and private sector management and engineering consulting organizations. These facilities are substantial resources which the centre must cooperate with, but knowledge of existing services is fragmented and there are numerous access barriers for medium and small businesses. The market for these services in industry far exceeds the established service capability. The centre must not compete with established service facilities, but encourage their growth for the ultimate good of consumers of their services in industry and the development of a stronger service sector in the province. There is a clear need for a clearing house and referral capacity within the centre to compliment and enhance the effectiveness of our established resources and facilities through coordination to optimize utilization.

To further enhance information distrtibution and co-ordination it is recommended that the centre establish "satellite" links to B. C. community colleges, universities and research facilities. These "satellites" would involve terminals to provide remote access to the library and data bases developed by the centre.

The Mission of a Centre in B.C.

The recommended objectives for the provision of services by a centre for B.C. industry can be summarized by the following MISSION statement:

"The B.C. Industry Productivity and Innovation Services Centre will provide business management and technology support services for the improvement of B.C. Industries' competitive position by increasing productivity through volume growth and optimization of all business resources including material, capital, technology and human resources."

In carrying out this mission, the centre will place priority on:

1. Utilization of existing resources and services in British Columbia and the provision of a focal point and neutral ground for communication and coordination to promote their more effective use by industry.

2. Awareness of benefits and application assistance related to the application of new technologies to products, equipment, processes and total business resource management.

3. Provision of demonstration and familiarization services and facilities emphasizing the application of new technologies required by and related to the specific needs of individual clients and businesses.

4. Effectiveness of human resources at all levels of organization.

Notwithstanding these priorities, the growth of supportive new technology industries in British Columbia and the establishment of national and international market linkages or distribution networks can and should be a part of the centre's mission. Focusing, optimizing and promoting volume growth in B.C. industry will help provide employment and encourage the overall growth of the economy.

Services to be Provided

To carry out its mission, the Productivity and Innovation Centre will provide a wide range of services. All such services will be aimed at assisting B.C. industry to become more competitive and more productive. These activities will cover:

- promotional and outreach programs
- consulting services
- training, familiarization and demonstration services
- information and referral services

The delivery of these services will vary depending on the specific industry being addressed, their level of awareness and employment of new technologies, and the availability of such services from other facilities or resources.

The services must also be "packaged" to address the needs of industry in a manner which is meaningful to the Centre's clientelle and relates directly to business issues (a description of services is provided in Chapter 6(e)).

Organization of the Centre

The recommendation of the study team and the Executive Advisory Committee is that the centre be organized as a private corporation. Almost all existing technology centres plan to become corporations at some time. The public agency and foundation structures that are currently used have more to do with regulations associated with the sources of public funds than with the management, promotion and delivery of services. Guarantees and assurances associated with maintaining responsibility for the disbursement of public funds can be structured into a private corporation through appointments to the board of directors and agreements on the issuance of shares. The private corporation offers the greatest flexibility and helps encourage:

1) private sector contributions and participation in the centre through share holdings;

2) attracting and maintaining highly skilled senior professionals (it has been recommended that all key personnel be shareholders of the centre);

3) maintaining contact and credibility with industry in the private sector as well as best facilitating staff mobility (i.e., the circulation of skilled individuals through the centre and back to industry for employment and vice versa);

4) maintaining the independence and neutrality required for the centre to operate effectively in an advisory role for government, education institutions, labour and industry;

5) assuring market driven operations and facilitating a profit orientation so that the centre may ultimately become self-sustaining.

Funding Requirements

A detailed breakdown of funding requirements and a budget outline have been provided in Chapter 7(b). In summary, the total cost of the centre as outlined is approximately $17.2 million over five years, with a revenue potential of $4.5 million over that period. This results in a net requirement for $12.7 million in additional funds. The following table details these funding requirements by operating year.

FUNDING REQUIREMENTS

(All Figures in Thousands of Dollars)

REVENUE	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
EXTERNAL FUNDING	2,500.0	3,220.0	2,570.0	2,210.0	1,560.0	650.0	12,710.0
CENTRE REVENUE	85.0	455.0	710.0	1,030.0	1,375.0	860.0	4,515.0
TOTAL REVENUE :	2,585.0	3,675.0	3,280.0	3,240.0	2,935.0	1,510.0	17,225.0
EXPENDITURE							
SALARIES & BENEFITS	143.4	705.3	1,072.7	1,236.6	1,298.4	681.7	5,138.0
OTHER OPERATING	931.0	1,863.0	1,807.0	1,636.0	1,523.0	763.0	8,523.0
SUB-TOTAL:	1,074.4	2,568.3	2,879.7	2,872.6	2,821.4	1,444.7	13,661.0
CAPITAL EXPENSE	1,480.0	1,093.0	388.0	350.0	100.0	50.0	3,461.0
TOTAL EXPENSES :	2,554.4	3,661.3	3,267.7	3,222.6	2,921.4	1,494.7	17,122.0
CONTINGENCY :	30.6	13.7	12.3	17.4	13.6	15.3	103.0

The study team recommends that a single request for funding should be addressed to the federal government for a combination of funds from the National Research Council (NRC)) and the Department of Regional Industrial Expansion (DRIE). The funding requirements for each year as outlined have been rounded upward to provide for a small surplus or contingency. These contingencies in fact amount to less than 5% each year. In normal business planning, a contingency of at least 15% should exist. However, such a contingency should not be built with public funds.

An objective in developing a funding request should be to keep that request to an absolute minimum which is sufficient to ensure that the mission and objectives of the centre can be met with reasonable certainty for a period of three to five years.

Plan to Establish the Centre

In summary, a recommended course of action for the establishment of the centre would proceed as follows:

1) Incorporate and create a board of directors of industry representatives where each member gets a share or shares in the centre.

2) Develop and promote a funding request to the federal government for the initial capital required to set up the centre and assure its operations for three to five years.

3) Establish a turnkey management group who will be charged with the actual creation of the centre, its initial operations and the recruitment of permanent staff (operating under the direction of the board).

4) Develop share participation plan for centre staff and, as staff are recruited, give shares and/or options to all key employees.

5) Promote widespread participation in the centre by industry through the offering of shares. This and specific private placement initiatives will assist in funding the centre and increase private sector involvement, thereby increasing the assurance of the centre's ultimate success.

As the resource sector becomes more productive and reduces its workforce, and public sector employment levels off or is reduced, the only alternative for employment growth is the expansion of manufacturing and the service sectors. Existing manufacturing and service industries must be encouraged to grow and compete in international markets and the establishment of new enterprises must be encouraged.

Through joint cooperation and leadership of the public and private sectors in B.C., the medium and small business community can be provided a greater opportunity to grow and create new jobs. If this growth is to occur and be sustained, then all B.C. enterprises must meet the standards of our international competitors. That means we must be more productive, more innovative and have a capability to apply the best technologies available. The establishment of a Productivity and Innovation Centre is one means of encouraging the greater competitiveness and growth within the medium and small business sector.

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EMPHASIZING PRODUCTIVITY & INNOVATION SERVICES
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1. INTRODUCTION

1. a. BACKGROUND

Canada's share of world trade dropped from 5 per cent in 1970 to 3.6 per cent in 1981. Canadians have been accused of loosing their competitive edge in world markets because they didn't value it highly enough, but Canadian businessmen do know the value of international trade - every fifth job in our country depends on exports. The international market is large and everyone wants a piece of the pie, but competition represents a formidable problem. Competition has been increasing exponentially for the past 30 years and probably will continue to do so in both world and domestic markets. Canada has to scramble to increase or even maintain its share, and the same applies to every business in the country - even those currently dealing with only domestic markets.

Awareness of the seriousness and urgency of this problem has been growing rapdily. Much has been learned about the make-up of the problems and barriers. Many useful initiatives have been taken already, but we have only begun to deal with a series of large and complex problems.

Quality, productivity and management have been recognized as basic issues to competitiveness. It is also becoming increasingly apparent that the adoption of new technology is a key factor in attaining increased effectiveness in these areas. Many new technologies for these purposes are now commercially available, but are not being adopted and applied in Canadian industry at an acceptable rate. The timely and effective transfer of new technologies from innovators and suppliers to commercial users is a complex problem which has often become an absolute barrier with lethal implications.

The problem of technology transfer in Canada is acute. A recent Economic Council of Canada report, entitled "The Bottom Line: Technology, Trade and Income Growth", claims that the slow adoption of new technologies in Canada greatly threatens our standard of living. The report indicates that about 99 per cent of new technology in Canada comes from abroad and, that among the range of technologies studied by the Council, these innovations had been applied from 7 to 31 years before being introduced in Canada. The Council was also concerned about the spread of technology within Canada and sited the example of computers in British Columbia, which appeared eight years after their application in Ontario.

As a result of their concern for these matters, a group of industry leaders in British Columbia established the Western Foundation for Advanced Industrial Technology (W.F.A.I.T.). With a view to other initiatives taken across Canada, this group proposed the establishment of a B.C. CAD/CAM Technology Centre. They subsequently obtained assistance from the federal and provincial goverments to commission a formal study on the needs of industry in B.C. with a view to the potential establishment of such a centre. To assist in and guide the actual study, WFAIT selected a number of industry leaders from the manufacturing, resource and financial communities to form the Executive Advisory Committee (EAC). A study team was subsequently formed and has produced the following report under the guidance of the EAC. The membership lists of the study team and EAC are attached in Appendix B, i and ii.

1.b. TERMS OF REFERENCE

The terms of reference developed by the Western Foundation for this study were provided in the form of general objectives as stated as follows:

1) To assess the present and projected demands for CAD/CAM and related technology services in B.C. through a market analysis.

2) To determine the need for a Technology Centre based on the identified demands.

3) To identify and report on the structural and organizational options for a Technology Centre.

4) To analyze the capital and operating costs of the option or options appearing to offer the most potential, and to assess possible sources of capital and operating funds for a Technology Centre.

Further guidance concerning emphasis and scope was provided by the EAC throughout the study and final report preparation. This emphasis included a more focussed attention to the needs of those manufacturing firms that provide goods and services to the forestry and mining industries. Attention was also drawn to the special needs of the growing electrical and electronics industries in B.C.. While many manufacturing and service companies sell to a range of sectors, time and resources did not provide the opportunity for a more specialized analysis of B.C.'s agricultural and marine industries.

2. STUDY APPROACH

2. a. THE BRITISH COLUMBIA FOCUS

There are special problems associated with technology transfer in British Columbia which had to be addressed by this study. While the study examined the technology centre experiences in other provinces and countries, all reviews were conducted within the context of B.C. realities.

An important reality in British Columbia is that the manufacturing sector is, to a large extent, tied to the resource sector. While there are notable exceptions, a significant thrust to the study had to include an analysis of the equipment needs and trends in the forestry and mining sectors.

Another major difference between B.C. and other provinces or countries, is the very small proportion of manufacturing carried on by multinational corporations. Given that the major channel for technology transfer is the multinational, B.C. is at a distinct disadvantage. A further concern is that the major multinationals which supply equipment and parts to the resource sector are among the most advanced in applying CAD/CAM and flexible manufacturing systems.

In 1981 The Western Foundation for Advanced Industrial Technology proposed that a centre be established to help small and medium sized companies in the application of CAD/CAM technology. The WFAIT proposal also recommended that this centre should be private sector controlled with a mandate to become self-financing as quickly as possible. The task force was instructed to retest these principles through discussion during the in-depth interviews for the market research and to examine the proposed services for the Centre from the point of view of their ability to generate revenue enabling the Centre to become a self supporting entity. The task force found in all discussions with industry leaders that these notions were supported completely, so they form an integral part of the options prepared in the structural and organizational analysis elements of the study, as well as the final recommendations.

2. b. METHODOLOGY

A major constraint in carrying out the objectives of the study, was the budget allocated, relative to the broad and very ambitious terms of reference. In recognition of the modest budget provided, the project team recommended an approach that emphasized research and analysis of experiences previously undertaken, and interpretation of this data in the context of a proposed B.C. manufacturing technology centre. While original market research was conducted, the emphasis was placed on in-depth, qualitative analysis and interpretation rather than mass survey and quantitative analysis techniques.

The study methodology was designed to ensure that practical, business based options could be prepared for the establishment of a private sector controlled, and ultimately self-financing, technology transfer service facility.

A key factor throughout the study execution and report preparation was the interactive approach taken by the task force with the EAC. As the members of the EAC are themselves key industrial leaders in the province, their input to the analysis of market research in particular and the total study/report exercise was invaluable.

Detailed study activities undertaken by the task force concentrated on four major subject areas in the following order:

1) Market Research
2) Opportunity Analysis
3) Structural & Organizational Analysis
4) Financial Analysis

A more detailed outline of the methodologies employed in each of these areas follows, but generally the emphasis was placed on maximizing the use of existing data or experience of others, disucssion in the in-depth interviews and a continuing review with the EAC.

2. b. i Market Research

A considerable amount of market research on the application of new technologies has been undertaken in the past few years. The sources of such information are both public and private relating to B.C., Canadian and international industries. A bibliography of data reviewed during the study is contained in Appendix "C" of this document. The existing market data was reviewed in the development of a market research methodology and analytical framework. Of special attention, was the market study of B.C. demand for a technology centre prepared by B.C. Research. This is the only available B.C. based market study in the CAD/CAM area, and it demonstrated a very high level of interest and demand for technology centre services. This study was undertaken in 1980, employed a mailed survey and projected demand using statistical techniques. After three years and a changing economy, many of the hypothesis needed to be tested and more data was required on qualitative issues such as attitude, knowledge base and financial contraints to the application of new technologies.

This area was first addressed with a "desk-research" exercise which examined the detailed 5 year business plans for a number of technology centres (see Appendix C.i). Follow-up to this included attending a number of seminars or conferences (Appendix C.ii), the review of numerous studies and reports (Appendix C.iii), varous site visits to other centres and over 50 in-depth interviews with B.C. industry leaders. Findings were reviewed with the EAC and, as conclusions were developed, they were tested with follow-up telephone interviews (which included the managers of a number of established technology centres).

2. b. ii Opportunity Analysis

The opportunity analysis focused upon the resources and facilities which already exist, and plans for the B.C. marketplace which might relate to the operation of an industrial technology centre.

Since the original Western Foundation proposal for a CAD/CAM centre, there have been a number of developments and investments in CAD/CAM

technology in B.C., in both the private and public sectors. A noteable example of such expenditures, was the $17 million allocated to B.C. colleges through the Canada Employment and Immigration Commission's "Skills Growth Fund" to purchase CAD/CAM equipment and to train operators and technicians.

After a review of private and public sector initiatives in the area of technology application services, recommendations were prepared identifying the remaining service opportunities with options on how an industrial technology centre would relate to existing programs and services.

2. b. iii Structural & Organizational Analysis

The structural and organizational analysis entailed a detailed review of how existing technology centres have been structured. The task force reviewed the Ontario technology centres, New Brunswick's Manufacturing Technology Centre, the Canadian Institute of Metalworking Centre in Hamilton,the Industrial Technology Centre in Winnipeg, other Canadian initiatives and efforts in the U.S.A., U.K, Europe and Japan.

This exercise included a desk-research analysis of the business plans, organizational structure and the management of technology centre services for identified operational technology centres. This was followed by participation in the Canadian National CAD/CAM Meeting (sponsored by the Canadian CAD/CAM Advisory Council) held in New Brunswick in early November 1983. The conference was attended by the managers of the established Canadian Technology Centres as well as government and private sector representatives involved with operations or promotion of the establishment of new centres.

Interviews were conducted at the conference with various individuals, including the operating technology centres' managers, to determine in greater detail the clientele of the centres, the services performed and revenue potential from such services. The centre managers were further queried on equipment purchased, software, information systems, training, facility

arrangements, problems encountered in creating a centre, optimal organizational structure and generally any advice they thought would be helpful in deciding if/how a centre should be established in B.C..

Data collected from these activities was further developed during some on-site visits to established centres, reviewed during in-depth interviews, analysed with the EAC and tested in a follow-up telephone survey.

2. b. iv Financial Analysis

The initial stages of the financial analysis were built upon the activities of the structural and organizational analysis, the opportunity analysis and the market research. It was important at the earliest stage, to determine what financial data was required in the study, and determine a methodology to ensure financially relevant data would be gathered in both the desk-research and in-depth interview phases of the other study elements. Financial data gathered in the other study elements was compiled and analysed as a distinct study element.

This analysis included a review of hardware and software options, and estimates of B.C. specific facility costs and options. Costs for the provision of services and revenue potential were reviewed with managers of other technology centres. Computer financial models were developed and have been included to illustrate the funding requirements necessary to launch the establishment of the facility.

Potential sources of funding from both the private and public sectors were identified and various discussions were held to review the study and proposals conceptually. The principles and potential of obtaining funds from each source were evaluated in turns and recommendations have been made concerning this matter.

3. COMPETITIVENESS & NEW TECHNOLOGIES

3. a. AN INDUSTRIAL AND ECONOMIC PROFILE

3. a. i The Global Context

The 1982-83 world wide recession marks the end of the post war expansive era. This was a period which exhibited the following characteristics:

- high rates of industrial growth in developed and developing countries
- increasing consumer demand
- strong demand for primary products, a large proportion of which were secured from developed countries (including Canada)
- expansion in social and social security programs
- relatively high levels of employment in developed countries
- rising wages
- rising inflation in the later part of the period

The post recessionary period, commencing now, has been exhibiting the following characteristics.

- lower demand for primary products and falling prices
- shift of the sources of supplies for primary products to developing countries, where better grades of material resources, more modern equipment, lower wages and a hunger for hard currencies result in lower prices
- selective consumer demand with stiff price competition
- adjustments in social and social security programs
- increasing levels of unemployment in resource producing sectors in developed countries
- decrease in wage levels
- shift in production functions to newly developed countries

- fiscal debts and high rates of interest across the board
- structural changes in economies, to meet the competition through the application of new technologies
- high rate of investment in the commercialization of new technologies

From a global perspective, the rate of job creation and the standard of living within countries will depend upon their ability to produce better quality goods and services at lower prices. Enhanced quality control and productivity are the key elements of success. Investments in these areas will determine the future levels of employment and wages, and it is in these areas that the international economic battle lines are being drawn.

All of our major trading partners have recognized the high stakes involved and have taken major initiatives intended to secure their positions. Japan leads the world in the application of flexible manufacturing systems and in robotics with over 110,000 robots in place. The U.S.A. leads the world in the application of CAD/CAM and have about 8,000 robots in use today. The U.K., Germany and other western European countries lead the world in the application of NC and CNC machining. Germany has just announced a 3 billion mark technology investment and training plan as they forsee their traditional industries becoming uncompetitive and are concerned that they have fewer than 4,000 robots in place. Canada is lagging well behind all of these countries in applying new computer-based technologies and have less than 600 robots in place. All of these countries have recognized the importance of developing and implementing a total industrial economic strategy.

As second and third world developing countries apply new technologies to resource industries and manufacturing with lower wage structures, both our primary and secondary manufacturing industries are under extreme competitive pressure. Faced with these pressures, the North American and European economies will undergo major structural changes in an era when trade barriers will be reduced under GATT (General Agreements on Tarriffs and Trade) committments. While these agreements represent a positive move

for Canadian exports, they also present a dramatic opportunity for increased import penetration in our own domestic markets.

3. a. ii The National Context

The understanding of the problems and the challenge is now improving rapidly. The importance of improving our balance of trade and cutting down on import pentration into Canadian industries without the establishment of artificial controls is generally well understood. The promotion of research and development, plus technology transfer for productivity and competitiveness is now widely endorsed. A fundamental change has also occurred in federal government policy. In 1983, the Governments of Canada announced a technology policy which was founded on the thesis that productivity gains achieved through technological innovation are pivotal to maintaining Canada's competitive position in international markets. Consequently, this policy focuses on the development and application of technical and scientific knowledge to the industrial sector. The general objectives of the policy are as follows:

1) To strength the Canadian economy through the development of new technologies for producing goods and services and the wide spread adoption of new and existing technologies;

2) To manage the process of technological development so as to ensure that Canadians are aware of both the opportunities and the problems that might arise;

3) To ensure that the benefits of technology development are shared equitably amoung all Canadians in every region; and,

4) To create a social climate that places a premium on scientific and technological excellence, curiosity and innovation.

For this policy to be implemented effectively, it will require the active involvement of the business, educational institution and labour sectors as well

as government. These are issues which affect all Canadians and can only be dealt with through joint cooperation. Canadian industry must optimize the use of all our existing resources through cooperation and the development of new partnerships.

Employment concerns remain a critical factor within our economy and must remain a primary consideration in the development of policies and initiatives which address these matters. As stated in the recent study of job creation by the Canadian Federation of Independent Business, it is now widely accepted that large companies as a group are not increasing their aggregate employment. The net job growth is not happening and likely will not happen in the big business sector. Meanwhile, small firms and especially the younger firms and new startups among them, have afforded net growth and employment. It seems to constitute a widespread (if not universal) phenomenon that, in aggregate, large corporations have stopped growing as a share of the economy and small business is becoming a greater porportion of the economy. While the health of our large business sector remains of the utmost economic importance, we must ensure that new initiatives recognize and place a suitable emphasis on the smaller and medium-sized businesses on which so much of our future depends.

A major key to the health of all companies is volume growth. We must emphasize the development of new markets based on new products and innovations. Canadian innovators and small business have had many spectacular successes to date, but much opportunity has been missed. Canada's track record has been less than spectacular in the area of taking our own ideas through the commercialization process to manufacturing (in Canada) and effective international distribution. A greater attention in the future must be placed on new product innovation and commercialization.

The Government of Canada has recognized that becoming more competitive is a critical challenge for all Canadians. The February 1984 budget stated:

> "In order to keep Canada growing we must better equip ourselves to compete with our trading partners, both at home and abroad. That

means we must cut our costs and be more productive. We must be world class. The government is committed to strengthening the world trading system. We can grow and prosper only by raising our own standards, not by self-defeating attempts to cut ourselves off from the rest of the world."

Corporate strategies which address market trends and the role of technology within their own company and that of their competition are critical to the survival and growth of Canadian enterprise.

While major barriers exist to meeting this challenge, initiatives over the past few years have demonstrated that Canadians have a capacity to face up to the problems and work toward their resolution. The Canadian Manufacturers Association, for example, has taken a lead in clearly identifying the need for business managers to address their responsibilities in improving productivity. Other encouraging signs include the agreement of business, labour and government to cooperate in establishing the Canadian Labour Market Productivity Centre.

3. a. iii British Columbia

Following two decades of sustained growth, the British Columbia economy has not recovered from the impact of the most severe international recession since the 1930's. As a result of the sharp reduction in U.S. housing construction, the British Columbia forest industries faced their worst slowdown in 20 years, with roughly one third of logging and sawmill workers laid off. The global recession also resulted in weak foreign demand for British Columbia mineral exports and major mines shutdown throughout the province.

The broad employment related impact of this recession has been very dramatic in B.C.. The unemployment rate in 1981 stood at 6.7 percent, climbed to 12.1 percent in 1982 and averged 13.8 percent in 1983. While there was an increase in production volumes in B.C. in 1983, this was not reflected in an increase in employment. Recovery of employment can be

expected to continue lagging behind production as employers focus on increased productivity with present work forces and face uncertain markets for volume growth. Without a strong international demand for forest products and mined materials, those industries and the B.C. manufacturing and service sectors that sell to primary industries face a slow to no growth market and an uncertain future.

This decline in production and employment has reverberated throughout the B.C. economy. The following is a brief synopsis of major trends in the forestry and mining sectors and an overview of this study focus on the manufacturing and services sectors.

Forestry

Emerging from the recession, the B.C. forest industry faces a clouded future. The possibility of rapid growth rates recurring like those of the late 1970's is remote as the province enters an era characterized by timber supply constraints, a shift from "virgin growth" to managed forests, and a ceiling on the annual timber harvest, newly established by the 1980 Forest and Range Resources Analysis.

A number of factors threaten the competitiveness of the B.C. industry. These include rising costs of harvesting and production as the industry encounters declining quality and accessibility of timber supplies; high transportation, energy and reforestation costs; currency devaluations by competing producers such as the Scandanavian countries; and the high costs and obsolescence of some Coast mills. This has already resulted in the closure of some Coast operations and the need for substantial modernization expenditures in others. Retaining competitiveness will be critical to the future of the B.C. industry.

Competition from particleboard, plastics and electronic media have and will continue to modestly dilute overall demand for forest products. The most negative factor however is the use of recycled or waste paper. It is estimated that waste paper could account for up to 50% of the paper

industries' fibre requirements in Western Europe, and more than 40% in Japan by the mid-1990's. This would seriously reduce the demand for pulp. A more general problem is that future B.C. timber supplies will be similar to those from other countries. As the province adapts to "second growth" crops, B.C.'s advantage as a unique supplier of large, high quality timber will be eroded.

In the past decade productivity changes were substantial, (particularly in the logging, sawmill and plywood sectors) and widely devergent, (with rapid gains in the Interior industry offsetting stagnant or declining levels on the Coast). If continued and maintained at even half the rates achieved in the 1970's, by an industry facing heavy debt loads and seeking all cost cutting and technological improvements possible, the result will be modest but steady downward pressure on employment.

The introduction of high speed, small log processing technology, automatic lumber sorters, electronic scanning of logs to optimize cut and computer controlled saws, has affected both the overall level of employment and the types of jobs and skills required. Employment gains lagged behind production gains in almost all sectors, and significant shifts occurred away from lower skilled, labouring jobs in favour of higher skilled sawyers, mechanics, repairmen, electricians and sawfiler occupations. Future changes will focus on increasing wood utilization and recovery rates.

The combination of these factors produces an overall outlook of very modest growth in markets and hence production. While slight increases are possible in some sectors (notably sawmills, shingles and market pulp), declines are likely in others, such as veneer and plywood. The prospects for a return to the 30-50% growth rates of the past are extremely unlikely. Growth rates of 5-10% now represent ambitious goals.

Mining

Within B.C.'s mining industry, closures and layoffs have been extensive and some companies, for the first time in their history, have experienced or

losses (in some cases substatial or even fatal). Until principal mineral markets, (especially the United States, Europe and Japan) recover, mining will face hard times. As a result of this downturn, the balance sheets of the mining industry have been damaged by heavy debts, high interest rates and insufficient cash flow. When markets and prices improve, it is expected that many companies will concentrate on reducing debt and that few major new investments will take place initially.

Mining companies are concentrating their attention on the improved productivity of their workforce. This is particularly important when one considers that labour is the single most important component of operating costs for mineral producers in Canada, and that wage rates in many competing countries are less than an eighth or a quarter of those in Canada. In addition, applying the most effective technology available will remain a major preoccupation of B.C.'s mining companies.

The Manufacturing and Service Industries

In assessing the present situation in B.C., it is necessary to consider the 1982-83 recession as not just being a temporary phenomenum, but a longer term adjustment process. This adjustment calls for higher productivity in the primary sector and a rapid build up in the secondary manufacturing and service sectors.

Such a strategy is necessary to absorb the workers that will be laid of in the resource sectors as a result of the applications of new technologies and productivity drives. Therefore, the focus of attention should be on developing new and improved products in B.C. secondary manufacturing and services that enhance resource sector productivity.

The traditional Canadian approach of attracting American and European manufacturers to set up plants in B.C. will be very difficult in this new trading environment. To a large extent, the level of manufacturing activity in the United States and Europe will not increase sufficiently to allow the incremental shift of these activities to Canada or B.C. Therefore, the focus

must be addressed by building on the indiginous existing companies and encouraging the development of new companies in the secondary manufacturing and service sectors.

In British Columbia, there are about 2,700 manufacturing companies that account for about 30% of all employment. Of these manufacturing companies, about 70% are in the service sector of manufacturing. The loss of markets in the resource sector and productivity drives in the manufacturing and service sectors are effecting the relative size and capability of existing capacity. While it is necessary to build employment creation on these sectors, such employment creation must be related to new volume growth, new improved products and applying up front, the best technologies available.

3. b. THE IMPORTANCE OF NEW TECHNOLOGY TO INDUSTRIAL COMPETITIVENESS

In recent years, the application of new technology in industry has been concentrated largely in the area of process control. A major change now in progress involves the application of a very broad range of computer-based technologies which when packaged as a system collectively, are referred to as computer aided design and computer aided manufacturing (CAD/CAM).

It is important to retain this broad perspective of CAD/CAM recognizing that well planned, integrated systems (potentially employing many new technologies, but possibly only one or two) tailored to the precise needs, priorities and business objectives of each individual installation. Many technologies within this group will only apply to certain types of industries and certain sizes of companies, but the principles of CAD/CAM systems apply to all industries and companies from the very large to the very small. Proper business information, analysis and planning for essentially custom systems is mandatory - this cannot be purchased "off the shelf." A CAD/CAM system for any company must be the successful integreation of the appropriate technologies into a total systems for that business.

Lowering costs and rapid developments improving the flexibility and usability of such key elements as management information systems, computer graphics, design engineering, numerical control and industrial robots have encouraged more widespread adoption of the technologies in industry and have made the automatic factory a distinct possibility.

Some portions of the automated factory concept are already being achieved, particularly in Japan and West Germany, but also in the U.S.A. and elsewhere. The impact of the application of these technologies in terms of relative productivity is enormous, so the potential to establish an effective competitive edge based on the appropriate implementation of these technologies is very real. For this reason, all the major players in the international marketplace have made a major commitment to the development and adoption of these technologies within their domestic industries.

To enable effective development and implementation of these new technologies in industry, it is critical to develop a clear understanding of the similarities and the difference between the use of computers in process control and their use for CAD/CAM systems, particularly as they apply to manufacturing industries.

Comparison - CAD/CAM and Process Control

Attribute	Process Control	CAD/CAM
Computer Implemented	Yes	Yes
Real Time System	Yes	Yes
Embedded System	Yes	Yes
Sensor Based Inputs	Many	Few
Human Input	Minor	Major
Expanding Data Base	No	Yes
Objective	Control Stability	Information Forwarding
Output	Setpoints	Detailed Instructions
Major Users	Chemical	Initially: Discrete Parts
	Petroleum	Manufacturing
	Steel	Potentially: All Industry
	Pulp and Paper	
Socio-Economic Impact	Modest	Large
Period of Pioneering	1960-1975	1975-1990

Whereas the process control developments of the 1960's and 70's tended to affect only a modest number of large process industry plants, the developments today in CAD/CAM and the related new technologies present an enormous opportunity and a challenge which must be met by all of our manufacturing industries. There are approximately 32,000 manufacturing companies in Canada, employing 2 million persons. The manufacturing industry output accounts directly for approximately 20% of the GNP and employs a similar percentage of the total labour force. They also form a base which indirectly is essential to the support of a much higher percentage of the labour force and the overall economy.

All of our major competitors within the international marketplace have recognized the importance of these technologies and have embarked on major strategic programs to develop and implement these technologies. The reasons for doing this abound and are being presented by speakers at numerous conferences, but they all add up to one thing: "improved productivity".

In a report to the U.S. Congress on the need to encourage greater computer use on federal design projects, the following figures from a user survey in the architectural-engineering field were presented.

Primary Reasons Computers are Employed in the Design Process

45% - Tasks not practical manually
21% - Improved design quality
14% - Reduce design cost
13% - Speed up design process
2% - Reduce design errors
5% - Standardize design methods

The net of all these points is reduced COST and improved QUALITY - two issues of major importance in the equation of competitiveness.

A survey of current Canadian users of CAD/CAM systems for computer-aided design conducted by the Canadian Institute of Metalworking, showed the following figures for productivity gains achieved within one year of operation.

CAD Productivity Gains

% of Companies	Productivity Gain (within one year)
15%	300%
30%	350%
12%	400%
14%	450%
14%	500%
15%	700%

It is easy to understand that such large gains can have a tremendous positive affect on the competitive position of a company, however, it must not be assumed that such results can achieved automatically or without effort. The same study of Canadian industry identified the following major factors affecting CAD installation success:

Factors Affecting CAD Installation Success

- Management
- Cooperation of the staff.
- User knowledge
- Operator expertise
- The CAD system chosen

Similar factors apply to all of the new technologies. It is critical that a thorough understanding of the technology and its impact on the corporation's business is held by staff at all levels of the corporation. The technologies implemented must be components of well designed systems managed under carefully developed plans. Detailed planning and cost/benefit analysis must ensure the appropriateness of the technology for the application, satisfactory return on investment and feasibility of the ultimate operation before the commencement of the change process.

3. c. THE PRODUCTVITY CHALLENGE

3. c. i Accepting the Challenge

Whatever the understanding or the perceived importance of productivity may have been in the past, today's business manager and his team must take a long, hard top-down look at this issue, and solicit the support and dedicated effort of the entire organization to achieve dramatically higher productivity objectives in all areas. These new objectives must better reflect the needs, priorities and strategies of the business. Employees must understand that this is not a traditional exercise in profit improvement, but planned action for an improved standard of living and greater security. It may even be a matter of survival of the corporation.

To motivate appropriate reaction, the challenge must be related to the particular business and presented to the staff with knowledge and conviction by the business manager himself. Increased awareness and education of senior management and executives is, therefore, a crucial issue. The urgency of addressing this as a critical primary issue, key to the achievement of all longer term objectives cannot be over emphasized. This is the starting point for taking up the challenge.

3. c. ii International Competition

From the perspective of past decades of manufacturing management and business experience, the 80's pose the greatest challenge to the Canadian manufacturing industry. In the past, the growth rate of the Canadian economy averaged four to six per cent annually, while current forecasts for this decade range only from two to three per cent. The search for growth will result in more internationally competitive environments.

The General Agreements on Tariffs and Trade (GATT) will result in the lowering of Canadian import tarrifs over the next five years, from an average of 22 per cent to nine per cent. This will open our domestic markets to greater competition, competitors who command higher production volumes and lower unit costs. The search for higher production volumes and lower unit costs as dictated by the market place will force the integration of many Canadian companies if they are to continue to exist.

The following national productivity trend table places Canada at the bottom in progress. The spread in the rate of improvement, based on a comparison of manufacturing industries of the same nations, is even less favourable for our industry.

Productivity Trends

	Average Annual % 1950-67	Change in Productivity 1967-72	1972-77
Japan	7.4	9.2	3.5
West Germany	5.0	4.8	3.5
Italy	5.3	5.0	1.0
France	4.7	4.5	3.1
U.S.A.	2.4	1.1	0.6
Britain	2.2	3.0	1.2
Canada	2.5	2.8	0.8

*Business Weekly, September 15, 1980

The leverage, or compounding affect, of a higher rate of productivity improvement results in dramatic competitive advantages over time. To illustrate this case, consider the following comparison:

- Company "A" averages 2% improvement per year
- Company "B" averages 6% improvement per year
- In five years, Company "B" will have a 19% cost advantage
- In ten years, Company "B" will have a 35% cost advantage
- The gap in the longer-term is untenable, and may be converted into:
    - greater margins
    - lower prices
    - higher market share and
    - increased investment, as the momentum of high productivity accomplishment affords leverage and confidence for reinvestment

The capital formation rates which reflect business and individual earnings, saving rates and taxation policies, have a bearing on productivity growth. The capital formation and productivity growth table shows increased productivity for the nations with higher levels of capital formation, since a significant percentage of capital is directed for productivity improvement.

	Capital Formation As % of GNP 1961-76	Average Annual Productivity Growth 1950-77
Japan	33.0	7.0
W. Germany	24.3	4.7
Italy	21.0	4.4
France	23.2	4.3
U.S.A.	17.8	1.8
Britain	18.6	2.2
Canada	22.2	2.3

The table also indicates that Canada, in spite of a good rate of capital formation, has a poor rate of productivity growth, because it spends more on services and primary industry where productivity gain per dollar invested is lower, and underutilizes its working capital by using it for protection of long and unreliable production and distribution cycles, keeping high inventories.

3. c. iii The Japanese Standards

While in the development of new technologies, the United States is still leading (although by a smaller margin) in the management of business resources such as working capital, factory capacity, process equipment and effective use of people, new standards of excellence are being established by leading Japanese competitors. They are setting a new pace for our North American industry. Japanese leading industrial competitors:

- operate with less than one-third of our inventories
- experience less than one-third of internal and external quality costs
- deliver their products and services in less than two-thirds of the time.

These points amount to a tremendous productivity advantage. Considering their achievement of a higher rate of productivity growth as illustrated in the preceeding table, they have a great competitive advantage which we must accept as an international standard and strive to meet with all possible resources and haste.

3. c. iv A Practical Approach

As Canadian industry accepts the importance of international competitiveness and addresses its productivity, the biggest problem facing most managers is identification of the proper place to start and a practical approach for dealing with the problems as a part of a comprehensive long term plan. As the basic economic message comes home and Canadian industry begins to develop their own strategies for survival, there is more and more discussion about the goal of computer integrated manufacturing. The concept is not new, but increased awareness of the benefits continues to be an illusive objective.

For many, computer integrated manufacturing (CIM) is the total integration of computer-aided design functions with that of computer-aided manufacturing functions. It is this belief that has stifled the growth of CIM in the past. CIM is a marriage of three manufacturing subsystems.

- CAD/CAM
- MIS/BIS
- DBMS

CAD/CAM is the tool through which the manufacturer can achieve improved quality, shorter development cycles, reduced costs, etc., and in itself performs the designing and manufacturing functions.

MIS/BIS (Management information system/business information system) is the subsystem which provides for the information requirements of the entire business. This is the management of the product data base which consists of shortage lists, bills of material, master schedules, MRP dispatch lists and the total financial profile and controls for the corporation.

DBMS (Database management system) is defined by Hess as a powerful set of software programs which control complex file structures with a practical balance of integrity, security, resource costs and ease of understanding.

CIM cannot become truly operational until these three factors are fully integrated. As technology improves and costs decline these systems will become more affordable and easier to operate, however, the organizational and operational implications of such total systems on a business should not be underestimated. The impact can be enormous and the risks can be high. It is critical, therefore, that the managers in industry who must plan and manage the implementation of these technologies, must have a thorough understanding which will allow them to develop and manage proper implementation plans utilizing practical, phased or incremental approaches which are appropriate to their business and resources.

The challenge for a centre in B.C. must begin with increasing the sophistication of these managers and senior executives, increasing their awareness and capability to identify opportunities for the application for new technologies, and their understanding of costs and benefits to facilitate proper evaluation, selection and implementation as a part of comprehensive, long range strategic plans addressing all resources of the business.

4. B.C. INDUSTRY SURVEY FINDINGS

In the course of the market research phase of the study, the team interviewed senior executives from over fifty B.C. businesses. Senior executives were interviewed on-site and through a series of seminar discussions which also involved a combination of administrative, engineering and technical managers. The emphasis throughout the market research was to gather in-depth, highly qualitative data on present operations, future plans and capabilities to manage the implementation of new computer-based technologies.

During the interviews, executives were probed to determine their views and attitudes concerning the future of their businesses, the role technology would play in that future and their role in managing the application of new technologies.

The research sample was designed to cover a wide range of B.C. businesses with a concentration on the manufacturing sector. Within the mechanical, and the electrical and electronic manufacturing sectors, the sample included small, medium and large businesses. Throughout this exercise, the intention was to identify trends within B.C. businesses that related to the demand for services associated with the implementation of new computer-based technologies.

The interviewees represented the following industrial sectors:

- Mechanical Manufacturers	44%
- Electrical & Electronic Manufacturers	20%
- Resource Industries	18%
- Professional Services	18%

4. a. SUMMARY OF KEY FINDINGS

Most of the companies interviewed had suffered major diffuclties over the past two years of economic recession. The loss of markets, both domestic and international, has resulted in dramatic reductions in production volumes

and employment. Exceptions to this trend existed primarily among a few export-oriented electronics manufacturers. Generally, there was a lack of optimism about short term growth prospects, uncertainty about maintaining existing volumes and great caution with respect to future investment in new equipment.

The lack of available investment capital was identified as a major barrier to new equipment purchases. A large proportion of the firms interviewed were concerned about their present high debt ratios and fearful of a return to higher interest rates.

The overwhelming majority of these firms did not have a business plan that incorporated a strategy to purchase new computer-based technologies. Few of the smaller firms had a business plan at all, and very few had spent significant business resources on updating or following a formal business or strategic plan. The exceptions to this were the more successful electronics firms, subsidiaries of national or multinational firms and the larger resource industries.

There was a general awareness of CAD/CAM technologies among manufacturers and a desire to see such applications in their own enterprises. However, there was very little knowledge of what is involved in applying such technolgies, their potential impact on present operations and the role of management in implementing the change process.

Most the firms interviewed indicated they did not have the internal capability to assess and implement CAD/CAM technologies, and that technology centre services in assessment and implementation would be most helpful and used. Concerns were expressed about purchaser uncertainty in working solely with vendors on equipment selection and a need for a neutral non-sales oriented information and referral service. There was also a preference for a private (rather than public) sector directed service centre.

A number of the survey results were sector specific. The following sections of the report identify key findings grouped by mechanical manufacturing,

electrical and electronic manufacturing, resource industries and professional services.

4. a. i Mechanical Manufacturing

- most were specialty suppliers to a domestic market of forest and mining industries. The depression in the forestry and mining industries has had a dramatic impact on sales and lost volumes have not been recovered.

- the majority lacked a market research capability, to carry out and assess market trends at a domestic and/or international level. They had very little if any knowledge of their current market share or of where they stood with respect to international competition.

- most did not have computer-based information systems. Those with some computer-based applications were usually in the accounting and purchasing areas. This low level of computer-based business information on inventory levels, production processes, planning and bidding was widespread.

- a recurring theme in discussions with senior executives was "survival management". Recurrent phrases, such as, "where will i make my stand" demonstrated fear of an uncertain future and a recognition among most businesses, that they must concentrate their efforts to meet international competition in the areas where they have the best chance. How they will meet that competition remains uncertain.

- at senior management levels there was a general lack of awareness of their role in managing technological change in the companies. Many saw these issues as technical and the responsibility of engineering or technical personnel.

- professional and technical personnel had been exposed to new computer-based technologies through reading or trade-shows, but few have had any demonstration or operating experience. There was a high level of interest in knowing more and applying new techniques. Overall, few engineering

and technical managers were involved in corporate planning or sensitive to market or financial issues of business management and development.

- lack of access to CAD facilities limits bidding opportunities of B.C. manufacturers. Some contractors require only 2-3 weeks for accurate cost estimates - which requires a CAD capability. The presentation of bids on a computer-based format was identified as a useful marketing tool (to demonstrate a better image of the company). Many saw a technology centre as an aide in the transition to computer-based systems starting with costing and evaluation services related to bidding.

- there was a very low level of awareness of outside sources of assistance, such as public and private service organizations and federal and provincial government programs.

4. a. ii Electrical & Electronic Manufacturing

- many of the senior executives have engineering backgrounds and have a relatively high level of awareness of computer-based technologies.

- most did not have a CAD capability, but had a desire to be using CAD within the next few years. The major barriers at this time are the high costs relative to existing volumes and available capital. A high percentage would be users of CAD services in a centre as a transitional step to putting present design and information systems up on a computer.

- while the electrical manufacturers tend to be more export-oriented, their present market research capability is weak and many are uncertain of the validity of information currently available.

- while knowledgeable of computer-based systems, few have applied these systems to manufacturing operations (again, apart from accounting and purchasing).

- interfacing and networking of data processing, and CAD equipment was identified as a problem in all purchases or implementation plans. A technology Centre could help potential buyers arrive at complete specifications which could reduce such problems.

- most had some product development capability but were limited by the high cost of prototype development, testing and evaluation. Many also indicated a problem in identifying local suppliers as a barrier to product development.

4. a. iii Resource Industries

- the forest and mining companies interviewed had suffered major losses in production and personnel in the past two years and anticipate a period of slow growth for the next few years.

- senior management in resource industries are very sensitive to productivity and competitive issues. Internal productivity management concerns are generally a priority. Productivity issues at this time, in view of current levels of new technology implementation, tend to be more related to employee relations than technology.

- engineering and purchasing personnel in the resource industries are generally up to date, have a good knowledge of what technology is available world-wide and are aware of what the competition is purchasing.

- most have or are developing business plans which include the purchase of new technologies placing a heavy emphasis on integrated business information systems and office automation, as well as lower administrative overheads and better information reporting methods at all levels of the corporation.

- in mining, few major advances in new technology are anticipated in the short term. Their emphasis is more on improving the productivity of existing resources and developing new products and markets for minerals.

- Many opportunities do exist for improvement of existing products and services. They are concerned about international competition as less developed countries progress and apply the latest technologies within a lower wage cost environment.

- in forestry, considerable investment in new computer-based technologies has already taken place. The cost of new equipment is the major barrier in an uncertain lumber environment. Major changes in existing plants are anticipated in pulp and paper if the industry is to remain competitive. New processes and equipment will increase productivity and reduce labour costs significantly.

- the resource industries are generally well served by an existing network of research facilities and professional expertise established in-house and in professional service organizations in B.C. and from other locations across Canada.

- those companies that have recently invested in new, more productive computer-based technologies, have expressed concern about the lack of innovation from B.C. suppliers and the ability of suppliers to work together to meet a customer's precise needs and productivity goals.

4. a. iv Professional Services

- some CAD and CAD/CAM related profesional services are available on the market now, but very little of this is tailored to manufacturing needs. What is available tends to process and structural engineering or mapping services.

- there is a very small market research consulting capability in the B.C. services market. What does exist is tied to larger accounting firms and their expertise is drawn from eastern Canada.

- engineering professionals have suffered a great deal under the current recession. Approximately 27% of the 2,400 B.C. Professional Engineers

were consultants. More than 500 of these are now unemployed. About 86% of those unemployed are in three disciplines: civil structural, mechanical and electrical, where CAD is directly related. In addition, many 1982 and 1983 UBC graduates have not obtained engineering related employment. In April of this year, 400 new UBC engineering graduates will come on the market with dim job prospects.

4. b. INDUSTRY SURVEY CONCLUSIONS

4. b. i The Concerns of Local Industry

- a return to pre-recession business growth and profits will be difficult if not impossible. Part of the manufacturing industry volume growth is permanently lost and the search for replacement volume for medium and small industries is very difficult owing to a lack of market research capability and information, as well as strategic evaluation of market trends and alternatives. This is further aggravated by the low level of expertise and application of CAD, computer aided manufacturing equipment and business information systems.

- CAD systems and other new technologies are needed to help assure the greater quality, reliability and faster delivery which is now more frequently demanded by prospective customers.

- while a majority of the manufacturing firms demonstrated a general awareness of CAD/CAM technologies and a desire to purchase these technologies in the next few years, an analysis of their current operating and information systems demonstrated that most lack the information and capability to make an assessment decision (let alone implement CAD/CAM systems). Before CAD/CAM can be applied, a business must have reliable information on their total manufacturing process and the ability to transfer that knowledge to a more integrated and sophisticated system.

- lack of capital is most often identified as the major barrier to purchasing CAD/CAM systems. While capital is a problem, the analysis shows the major problems are lack of volume and uncertain markets to justify the acquisition, lack of information on available working production methods and ineffective use of current capital.

- the executive level of manufacturing businesses require an independent and objective centre for market information, analysis and evaluation. This service would be directed to help B.C. industries search for the replacement of lost volumes and opportunities for future volume growth.

4. b. ii Identification of Productivity Opportunities for Volume Growth and Lower Costs

- the services of a centre should be focused primarily on the needs and participation of senior industry executives.

- an immediate need of senior executives is an independent centre to provide a single comprehensive source of market information, analysis and evaluation services directed to help B.C. industry in search of replacements for lost volume and future volume growth. This centre should have the capability to provide executives with advice to evaluate alternative strategies related to medium and small business strength, its particular financial and technological capabilities, and longer term market trends.

- business services should be directed toward "productivity" based issues, analysis and managing the implementation of new computer-based technologies. This would serve as a training ground to upgrade the skills at the executive level of business management. The focus would be on the improvement of the business's competitive position and productivity through the optimization of all business resources including human resources, material facilities, equipment and financial resources.

- the emphasis on productivity issues is more attractive to senior businessmen and more likely to ensure their participation. The notion of a "technology" or "CAD/CAM" centre is too often a signal to senior executives that the centre is for technical or engineering staff rather than themselves.

- a productivity emphasis also provides the opportunity for greater contact between business executives from the resource and manufacturing sectors. All business executives share a common concern for productivity issues. The improved competitiveness of local suppliers is also in the interest of and related to, the productivity of resource industries. This interaction among senior executives with a common and shared problem, should be a primary method of encouraging participation and helping to identify plans of action for corporate survival and growth.

- the emphasis on volume growth also addresses an immediate need and market entry point for other centre services. It focuses attention on the key issues to justify the application of computer-based manufacturing technologies and the fact that their costs and future profitability are primarily related to efficiencies in greater production volumes. The barrier to purchase is not just availability of capital, but capital related to return on investment and production economies based on volume.

- the involvement of senior executives in these productivity issues will lead to the development of business plans which include the implementation of new technologies and a definition of the role of senior management in carrying out such a plan. The supporting services to implement such a plan would come in part from the centre and through referral to other areas of expertise.

4. b. iii Business Information Systems

- there was a large capability deficiency among manufacturers who indicated they expected to purchase CAD/CAM related products in the next few years, but whose current business information systems (which should

provide the fo ndation) were quite inadequate. The analysis showed current application levels of manufacturing information systems such as scheduling, materials, inventory control, maintenance and spare parts purchasing are very low.

- most of the manufacturers interviewed were realistically one to two years away from being in a position to make a proper assessment and educated decision, much less to purchase and implement a CAD/CAM system. This indicates there is an immediate need to focus on lower cost, management information systems. This is a necessary first step in computer control of manufacturing and a prerequisite to assessment of future CAD/CAM applications.
- this also demonstrates that executives are aware they need computer-based systems but are unaware of what they need to know to assess, purchase and manage such systems in their plant or business.

- to serve their needs, a centre should provide for demonstration, evaluation and implementation services for computerized manufacturing, business and management information systems. Systems and services should focus on increasing bidding capability, shortening bidding times, order processing and improving product delivery cycles to reduce capital tied-up in inventories and unproductive operations.

- the centre should provide a referral service and objective advice for users on the selection of appropriate software and hardware, as well as the costs and benefits involved in system implementation and operations.

4. b. iv Product Development

- A significant demand was identified for shared access to a versatile CAD facility. Such a facility would be supported by equipment software and technical expertise to assist clients or train clients to use facilities on their own. These CAD facilities would be used for design and product development as well as competiitive bid preparations. In addition to equipment demonstration, the services should include an analytical testing and evaluation capability.

- For many users, such a CAD facility would serve as a transition and testing ground to enable them to develop the capability to implement their own CAD facility at a later date and at a lower risk.

- The market for such services in the short term would include those mechanical manufacturers with NC or CNC equipment, electronics firms, plastics firms and consulting engineers.

- Apart from the provision of shared access to hardware, software and technical expertise, an opportunity exists to identify areas of product improvement and new product development related to the productivity and competitive demands of the resource industries.

- Through a producitivity centre, resource industry equipment buyers could work with B.C. suppliers identifying their improved and new product needs. Such cooperation with an understanding of manufacturing sector expertise and resource industry needs, could lead to new product development opportunities based on domestic demand leading to export potential.

4. b. v Production Hardware and Related Equipment

- B.C. industry executives have a very high level of interest in CAD/CAM equipment and a desire to apply such technologies in their manufacturing operations. The research also demonstrated however, that very few companies are in a position to assess or apply such technologies, and that very often senior management does not know where the process should begin.

- Services should be provided by an impartial centre to help increase the sophistication of the would-be buyer -- to help identify appropriate technologies for specific applications, conduct accurate cost/benefit analysis and assess/evaluate the alternative solutions.

- A CAD/CAM demonstration facility with training, guidance, advice and referral capabilities should form a part of a centre operation. A range of

automated production equipment should be established reflecting equipment within the price and application horizon of medium and small business.

- The market research also showed that few B.C. manufacturers had invested in computer-based, process and quality control equipment. Advice, guidance, training and referral services in process and quality control equipment and related information software systems should form a part of the facility mix of the centre. Such equipment and systems facilitate diagnostic and preventative actions to maintain quality, continuity and reliable operations.

- There is a significant unused capacity among many plants in B.C. that now have NC and CNC equipment. While a centre would have significant CAD capability, CAM operations could be limited to smaller scale demonstration and training equipment, referring clients to existing large scale NC and CNC equipment as necessary.

4. b. vi Effectiveness of Human Resources

- The market research showed that there is a need for advice, training and referral services associated with applying new technologies at all levels of corporations.

- At senior executive levels, the emphasis should be on exposure to new technologies and the opportunity to share experiences with other senior executives who have managed the application of new technologies. There are many policy issues related to a corporate productivity focus, applying new technologies and employer/employee relations planning re-training programs, counselling and communciation that senior executives need to be familiar with.

- At middle management and professional levels, technical disciplines and expertise are being eroded or outdated by advances in new technologies. Current managers desire an opportunity to upgrade their skills and to learn the best methods to apply new technologies in their area of responsibility.

- At an opperations level, the worker's role often changes from a materials handler to a process control manager. There is currently very little awareness of or experience with new computer-based technologies on the shop floor. These workers need an opportunity to be exposed to the new technologies.

- While a training facility should form a part of the centre's services, the emphasis should also be on referrals to existing programs and courses being offered by educational institutions and private sector training services. A key need identified was to provide assistance to "train the trainers" or supervisors, managers and executives who have leadership and training responsibilities within corporations.

5. OPPORTUNITIES IN B.C.

The thrust of this feasibility study has been toward a focus on productivity issues and the role of technology as a major element in increasing the competitiveness and growth of B.C. industries. Within companies the fundamental perspective is maximizing the utilization of all business resources. From an external perspective, there is a vast array of resources and services available to companies, or with a potential to be utilized. This opportunity analysis will provide an overview of external resources and identify areas where a productivity centre could deliver services to facilitate greater corporate access and utilization.

5. a. ESTABLISHED RESOURCES & FACILITIES IN B.C.

5. a. i. Community Colleges

When WFAIT proposed the establishment of a CAD/CAM Centre for B.C. in 1981, there were no CAD/CAM facilities available with private sector access and those in existence provided very limited demonstration and training opportunities. Since that time the federal government, through the Canada Employment and Immigration Commission (CEIC) and the Skills Growth Fund have committed over $17 million to the establishment of CAD/CAM and related technologies training in B.C. community colleges. These facilities are primarily oriented to two year technological programs in occupational areas designated as of national importance and where skilled technicians are in short supply.

Within the past year, CAD/CAM training facilities were approved for the College of New Caledonia (CNC), the British Columbia Insititute of Technology (BCIT), the Pacific Vocational Institute (PVI) and Kwantlen College. While funding was approved through CEIC, responsibility for administration of Skills Growth Funds was assumed by the provincial Ministery of Education, which has responsibility for the community colleges.

Each of the colleges that has received monies for CAD/CAM facilities has developed their own strategies for the involvement of industry in CAD/CAM related training. There are constraints however, as the provincial Ministry of Education has tied facility priorities to the two year certification of CAD/CAM and related technologists.

These facilities are primarily for concentrated training of new graduate technologists, with limited opportunities to expose students from other disciplines or to provide for skill up-grading of those already in the field.

The exception to these arrangements is the College of New Caledinia. CNC has helped establish the Northwestern Foundation for Advanced Industrial Technology (NFAIT). With the approval of the provincial government, the Skills Growth Fund resources have been transferred to NFAIT. The CAD/CAM capabilities of NFAIT have formed the basis for the establishment of the Northern Institute for Resource Studies (in Prince George). The Northern Institute is a non-profit, provincial research organization, founded to promote, encourage and advance the awareness, knowledge and appreciation of economic development in B.C., particularly in the northern area of the province. The priorities of the Northern Institute will focus on the needs and opportunities associated with the forestry and mining industries.

With the transfer of Skills Growth Funds through NFAIT to the Northern Institute for Resource Studies, this $2.8 million investment in CAD/CAM originally directed to CNC can be utilized for demonstration, product development and training purposes by private industry. CNC will be contracting training services to the Northern Institute to meet its needs.

The Northern Institute is located on the campus of CNC and will provide a central and comprehensive repository of maps, reports, studies, data and research material by business, government, various agencies and consulting groups relating to economic development in the northern part of B.C. The Northern Institute is also in the process of proposing a major federal contribution to advanced technological equipment and support services

associated with assisting the competitiveness of northern B.C.'s resource industries.

The Northern Institutes objectives of directly serving the advanced technological needs of the resource sector are most compatible with those of a proposed Productivity and Innovative Centre. A major thrust of the proposed Productivity and Innovation Centre is to meet the competitive needs of the manufacturing and service sector which to a large extent sells their products and services to the resource sector. If both centres are to maximize their opportunity for success it is imperative that they work closely together, share information, avoid duplication and encourage their mutual development in referrals and promotional activities.

With respect to the other CAD/CAM facilities in lower-mainland community colleges, the proposed Productivity and Innovation Centre should liase and work closely with them to assist in promotion and referrals to the courses and seminars, skills and other services they offer. It is most important that a new productivity centre not duplicate or compete with existing training and general educational services presently being offered.

The productivity centre's prime client market is at the senior executive level and professional, technical managers. Exposure at a productivity centre may provide a major market entry and referral opportunity for training courses and services being offered at community colleges.

There will also be many opportunities for senior executives to work through the productivity centre to advise community colleges on how they could best meet the training needs of industry in areas of advanced technology. An independent, private sector directed, productivity centre could avoid the duplication of each college establishing separate advisory bodies in addition to already existing advisory bodies in the ministries of labour and education.

A productivity centre could also work with community colleges and universities in developing industry access to existing testing equipment that may have application to private sector needs in product development, testing

or meeting bidding specifications. This would avoid duplicating expensive equipment and maximize utilization of existing resources.

The most important area where a productivity and innovation centre can work co-operatively with educational institutions is in the stimulation of demand for graduates with new skills. The market research from this study demonstrates that, without a significant effort to stimulate the competitiveness and volume growth of the B.C. manufacturing sector, there will be very little investment in new technologies within B.C. companies and the employment prospects for community college and university graduates in these desciplines will be very dim in B.C. We may actually be educating for the eastern Canadian and American marketplace.

5. a. ii. Universities

In the past three years, B.C.'s universities have responded to the challenge of greater industry-university cooperation in developing and applying new technologies and increasing the skill levels of industry managers. At the University of British Columbia, a Micro-Electronics Centre was initiated with federal government support. This Centre will ultimately be located at the Burnaby Discovery Park. CAD/CAM facilities, including vertical machining centres and robots have been operating at UBC for a number of years, providing UBC engineering graduates with exposure and skills in these fields.

The faculty of commerce and business administration at U.B.C. is one of the finest in Canada. The same is true for the engineering faculty. Unfortunately, while these skills are present in B.C. there are significant barriers to indentifying and assessing skilled personnel with the interest and entrepreneurial attitude to assist the medium and small business community. Given the proposed business services orientation of the productivity and innovation centre, it is recommended that the centre establish a direct linkage with the U.B.C. commerce faculty through the business leaders that participate on their advisory council. There are major sources of business information, personnel and equipment which could be accessed and utilized by the B.C. medium and small business community. The proposed centre could

form a channel for identifying, linking, referring and promoting information and services that could be better utilized for B.C. economic development.

At the new engineering faculty of the University of Victoria, a CAD/CAM and Robotics facility has just been established. They will be operating a co--op plan through which students will spend approximately half their time in industry. The University of Victoria has already established a working relationship, with the Northern Institute in Prince George, to share information and encourage referral activity. This fall, thirty students will start in the new program. In a short period of time the University of Victoria has assembled a very impressive technical capability in computer-based applications and has a very strong orientation towards working with, and responding to the needs of the private sector.

The University of Victoria facilities provide the opportunity for the demonstration of new technologies for business, particularly those on Vancouver Island. The proposed productivity and innovation centre should work cooperatively with the University of Victoria in sharing business information and may be of assistance in identifying co-op placements for students, promoting the technical services that could be provided by the University and in stimulating a greater awareness of productivity management issues.

At Simon Fraser University, a new engineering program has been established teaching CAD/CAM as a one year course within their engineering ciriculum. They also have a joint program in place with AEL Microtel Pacific Research for custom chip design and manufacturing.

Similar to other universities and colleges, a productivity centre could provide referral and promotional opportunities on courses and seminars, identify and match technical and professional resources, and develop employment opportunities for graduates.

5. a. iii. Research Facilities

During the course of the feasibility study, the operations of existing research and development facilities were investigated. The facilities and organizations included B.C. Research, Forintek Canada Corporation, The Forest Engineering Research Institute of Canada, The Pulp and Paper Research Institute of Canada, The National Research Council's Western Laboratory, The Science Council of B.C. and The B.C. Discovery Foundation. A brief outline of these organizations is attached within Appendix A.

These organizations represent a large and diverse array of technical capabilities, information and services. The sheer number and complexity of facilities and services is a significant barrier to awareness and access by medium and small businesses. While many of these facilities are oriented to research and development projects of a large scale and for major resource clients, there remain many market opportunities for medium and small business as suppliers or as a source of innovation information for their own product development and marketing activities. At present there is no clearing house or single information source on these facilities to guide medium and small business and to provide referral advice.

5. a. iv. Government Programs

A wide variety of programs and services available to industry were investigated during the course of this study. A brief outline of the major funding sources of the federal and provincial governments is attached within Appendix A. The two major sources for medium and small businesses are the Industrial Research and Assistance Programs (IRAP) of the National Research Council (NRC) and the Industrial and Regional Development Program (IRDP of the Department of Regional and Industrial Expansion (DRIE).

In the case of the NRC, the Industrial Services division has been the leading promoter of technology transfer and revenue source for technology centre across Canada. If a Productivity and Innovation centre is to be established, it would have to work closely with the NRC from the very beginning and draw upon their expertise and experience.

DRIE now works closely with the Federal Business Development Bank (FBDB) distributing information on programs to industry. In B.C., the FBDB have seventeen regional officies and will soon have a computer-based capability to provide information on government programs. If a centre is to be established, a terminal should be installed and personnel should be available to refer businessmen to the appropriate departments. The new DRIE, IRDP will now provide monies for corporations to carry out market research. As identified in the market research, most B.C. companies have very little market research capability. A productivitv and innovation centre should develop a capability to assist companies to increase their market research management skills and take advantage on the new areas of program support.

Information and referral information should also be available on Provincial government programs and services at the centre.

5. a. v. **Other Resources**

Linkages, information, promotional and referral capabilities should also be established with industry and professional organizations that have an interest and are active in productivity related issues. In particular, the information on programs, seminars and initiatives of the following organizations should be monitored and promoted:

The Canadian Manufacturers Association of Canada - B.C. District
The Vancouver Board of Trade
The Employers' Council of B.C.
The Machinery and Equipment Manufacturers Association of Canada - B.C. District
The B.C. Technologists Association
The Engineering Association of B.C.
The Data Processors Management Association

Clearly, the existing institutional, governmental and service resources of B.C. are most significant. The problem for businessmen is keeping informed and knowledgeable of how these organizations and services could be applied to meeting their competitive challenges. A productivity centre could be a source of such information and advice.

At the same time, in this already diverse and somewhat fragmented marketplace, it is important that a centre not be, or be perceived as, just one more of a multitude of competing agencies. The centre must be a force for drawing together and encouraging the development of the private sector services within existing organizations.

5. b. NEW NATIONAL INITIATIVES

5. b. i Canadian Labour Market and Productivity Centre

In January 1984, the federal government announced an agreement to establish the Canadian Labour Market and Productivity Centre as a joint undertaking between business, labour and the federal government. The federal government has committed $27 million over the next four years to the Centre's operations.

The proposed Centre will examine the issues of productivity improvement, labour market requirements and employment growth in Canada. The Centre will be divided into two branches: the Productivity and Employment Growth Branch, which is to involve labour and business in examining productivity in both the public and private sectors; and the Labour Market Branch, which will examine the supply and demand for key skills and make recommendations to address these issues.

In the Budget Speech of April 1983, the federal government called for an examination of a national productivity centre with such examination to be jointly undertaken by business and labour. A joint steering committee was established and Co-Chaired by the Business Council on National Issues and the Canadian Labour Congress.

In August of 1983, the federal government announced the establishment of a Labour Market Institute, jointly managed by business and labour. The Labour Market Institute was funded for $10.7 million, and was to study and advise the government on labour market conditions and policiies for the skilled trades.

The steering committee of business and labour examining the productivity centre, recommmended that the Productivity Centre and the Labour Market Institute be combined. This recommendation was accepted by the federal government and the $10.7 million has been transferred to the new Canadian Labour Market and Productivity Centre.

This proposed Centre will be a private sector organization, incorporated under Part II of the Canada Corporations Act and have a budget of $5.6 million for the first year and approximately $7 million for each of the subsequent three years.

The Centre will be governed by a Board of Directors made up of 12 labour representatives, 12 business representatives and 2 educators. In addition, there will be 14 exofficio, non-voting government representatives, four from the federal government and the remaining ten to be offered to provincial governments.

While a decision has not yet been made, this Centre will most likely be located in the national capital region. This is to be primarily a research and policy advice organization not directed to solving the problems of individual coporations.

This organization represents a formidable challenge to both business and labour to work together and find a method of reaching consensus on key issues related to productivity and technological change.

Unfortunately no British Columbians have been involved in the steering committees or planning for this Centre. At this point there is a very low level of awareness among business and labour about the intentions and opportunities provided by this initiative. One can expect however, that there will be British Columbians appointed to the Board of Directors, hopefully from both business and labour.

It is the intention of the national Centre to develop a capability to respond to regional needs and priorities, and to eventually gain financial support from the provincial goverments, regional businesses and labour organizations.

With respect to the proposed B.C. productivity and innovation centre, there are many opportunity areas to open a direct liaison with the national Centre, and to encourage the B.C. productivity centre to be the communications and information link. As the priorities of the centre in the productivity area become more clear, the national centre may be a source of revenue for studying policy issues that relate to areas of concern in B.C..

Similar to the proposed B.C. centre, the national Centre encourages the participation of senior management. A linkage between these two centres could encourage greater peer level dialogue on productivity issues.

Given the labour participation in the national Centre, it is imperative that labour participate with membership on the Board of Directors of the B.C. centre. There are, however, significant differences in the orientation and activities of the B.C. and the national Centre. It is not recommended that the B.C. centre be on a 50/50 partnership with organized labour.

In the first place, the B.C. centre is concerned primarily with addressing the needs of individual corporations and not with broad public policy issues. Labour should be involved in understanding productivity issues and work with management to resolve these issues. The prime responsibility and leadership for productivity must come from senior management. Labour should be involved on the Board of Directors and in a formalized committee basis within the Human Resources division of the B.C. centre.

5. b. ii The Institute for Manufacturing Technology

The National Research Council has begun work on the site for the new $41 million Institute for Manufacturing Technology in Winnipeg, scheduled for completion by late 1985. The Institute will be a national centre for information, advice and appplied research and development in the areas of advanced manufacturing, CAD/CAM, robotics, flexible manufacturing and artificial intelligence.

As a national centre, the mandate of this centre includes the distribution of information on advanced manufacturing technologies to other centres across Canada. The B.C. Productivity and Innovation Centre should be one of the distribution points for this information.

In cooperation with B.C. Research, the Northern Institute and the CAD/CAM facilities based in education institutions, standards and procedures should be established to ensure that compatible information systems are developed for sharing information between each facility and with the NRC Institute for Manufacturing Technology. Duplication should be avoided (thereby reducing costs) policies and procedures developed to facilitate effective cooperation to meet the common objective of efficient technology transfer to industry.

The resources of the new NRC national centre are considerable with staff expected to grow to 100 scientists, engineers and technicians by 1986. The NRC leadership in Winnipeg should be of significant assistance to technology transfer and better information access for business in B.C. and across Canada.

5. b. iii Canada's Rail Expansion Program

With the passage of the Western Grain Transportation Act and with the end of the historic Crow Rate, Canada's two major railways have committed themselves to the largest rail expansion and upgrading program since their orginal construction. The estimated capital expenditure commitment of the Canadian Pacific Railway and Canadian National are in excess of $16 billion over the decade.

The impact of this spending in British Columbia is most dramatic. Capital expenditure commitment of both railways in B.C. are $1.1 billion. The federal government estimates that the spinoff economic development impact in B.C. could be approximately $5.4 billion over the decade. The impact on employment alone is estimated at 87,000 jobs and $3.1 billion in labour income.

The B.C. portion of this megaproject is twice as large as the North East Coal development. The $600 million commitment on tunnelling at Rogers Pass is the single largest construction project underway in North America today.

During the passage of the Grain Transportation Act, both railways committed to encouraging the local supply of goods and services in those regions where construction was taking place. To be competitive, however, suppliers must meet standards of quality, reliability and costs.

This major construction activity represents an opportunity for many medium and small businesses to identify sales and volume growth opportunities related to major rail developments planned in the United States and in other world markets. An opportunity exists, but one must recognize that this is a highly competitive market.

To assist B.C. companies in identifying opportunities and participating in rail expansion benefits, major B.C. industry associations have formed an umbrella organization called the Rail Expansion Industrial Benefits Committee. The membership of their committee includes representation from the following organizations:

- The Mining Association of B.C.
- The Council of Forest Industries
- The Employers' Council of B.C.
- The Port of Vancouver
- The Vancouver Board of Trade
- The Road Builders Association of B.C.
- The Electrical Manufacturers Association of B.C.
- The Canadian Manufacturers Association - B.C. District

The objective of their organization is to identify ways and means to encourage B.C. corporations to take advantage of the economic opportunities associated with rail expansion.

The proposed Producitivity and Innovation Centre should work with this committee to help develop better market information and provide technical support for those companies which may require support in bid qualification, bid preparation, testing and evaluations.

The rail expansion is a significant and immediate business opportunity for industry in B.C. The proposed centre should focus its development of market research and service development capabilities on this sector as a priority. This will provide a window of opportunity with major export potential. By targeting service development to an area of activity where major spending is occuring in the province, market entry for centre services may have the potential of demonstrating immediate economic return for clients.

5. c. RESOURCE AND TRANSPORTATION INDUSTRIES

The economic engine of B.C. for now and in the foreseeable future, will be the resource industries. While the growth rates sustained by forestry and mining over the past two decades will level off, their net contribution to the B.C. economy in terms of employment and opportunities to supply goods and services, will remain the primary focus for the prosperity of B.C.

As these basic industries undertake the competitive and productivity challenges to meet their international competition, the B.C. manufacturing and service sectors that wish to sell to these industries must orient their corporate goals to the design, production and delivery of products that increase the productivity of resource companies.

A major challenge for a productivity and innovation centre is to provide a forum where senior executives of the manufacturing sector can interact with corporate executives from resource industries to address opportunities for B.C. manufacturing and service sectors to work towards meeting resource sector goals. This opportunity of working together on site and in local forums is a key advantage that B.C. suppliers have over the international competition. Development of expertise within the manufacturing sector to meet client's needs, to refine, modify or develop and test new and innovative products should be a major focus of the productivity and innovation centre.

Opportunities for interaction and sharing information should be structured into the centre, both at the Board of Directors level and in sector specific working committees involving professional disciplines. Maintaining the executive level interactive process and supporting it with information and technical expertise, will be vital to the long term development of the centre.

This study focused on the mechanical manufacturers, electrical and electronic manufacturers and developments in forestry and mining. If a centre is established, the focus should be broadened to include services to the manufacturing and service sectors which market to the oil and gas, marine and agricultural industries.

Another major area of centre activity should include a focus on the transportation equipment sector. Beyond the rail expansion program, significant market opportunities exist in urban transportation. B.C.'s capacities in this area have been increased significantly through the development of the Vancouver urban transit system. Total cost of the system is projected to be $854 million. More than $400 million of that will be spent on manpower, material and equipment in B.C. In the next 20 years the world market for urban transit systems is expected to exceed $400 billion.

Forestry, mining and all other resource industries are also significant users of transportation equipment, representing a large local market with export potential for products and services from B.C. manufacturers.

Also within the transportation sector, shipbuilding and supplying the material and support services associated with upgrading and improving the productivity of B.C. port facilities represents a substantial opportunity for industry in B.C..

Vancouver is a major service centre for maintenance of the C.P. Air fleet and to a lesser extent, other airlines. Vancouver is also only 120 miles from Boeing Aircraft in Seattle and at this point in time, there is very little B.C. participation that market.

The transportation side of defence industries on the west coast of the United States is an unexploited market for B.C. industry. Seattle is a major submarine base and San Diego is the major supply centre for the U.S. Navy Pacific fleet.

The transportation focus ties in with preparations for EXPO 86 and its theme of transportation and communication. Assisting medium and small business to prepare for the market development and sales opportunities provided by EXPO should be a focus in the development of services for centre clients.

6. A PRODUCTIVITY SERVICES CENTRE FOR B.C. INDUSTRY

6. a. THE CONCEPT BEHIND EXISTING TECHNOLOGY CENTRES

Technology transfer facilities or technology centres have been set up in Canada, Europe and the United States, with varying mandates and as a result of many different types of initiatives. While a variety of services have been performed ranging from information, applied engineering, consulting and training to pure research and development, the essential purpose has been the transfer and application of productivity-improving technologies and product development processes. Industry and government have found there are a number of problems, if not substantial barriers, related to the transfer of existing technologies and the development of new technologies. Centres have been created to address these issues within the contexts of local industries, concerns and resources, to help ensure the health of existing industry and the development of new industries.

In the past ten years, the pace of technological change has been faster than at any other time in history. The absolute volume of new technological innovations, particularly as a result of the application of electronics in all industries, has spurred the growth of international competition in trade at a rate and scale never before experienced. All of these facilities or centres have been created as a result of a desire to compete effectively and survive within the international marketplace, and a recognition that the ability to survive and compete effectively, is dependant upon the effective introduction of new technologies into all of our industries. Government is concerned that, if existing manufacturing fails as a result of its inability to be competitive, this will have a direct negative impact on jobs, which translates to a negative impact on government revenues - i.e. if corporations fail, unemployment is created and this immediately decreases personal and corporate tax revenues. All the implications concerning the overall economic health and security of our nation and province are profound.

The experiments in the last decade have concentrated on establishing technology transfer agencies which addressed three service areas important to B.C. industry:

- Information Gathering and Distribution;
- Demonstration of New Technologies;
- Assistance in the Implementations of New Technologies

Technology transfer agencies have become important elements in regional and national industrial and economic policies. Each region and country has established different models based on local circumstances and existing resources. In the U.K., such facilties were initially created within the universities providing information, demonstration and technological skills. These centres have now evolved and are moving toward a greater private sector orientation. As an example, the Cambridge CAD/CAM centre has recently been privatized. In the U.S.A. , there are examples where centres are 100% private sector based. Some large companies, such as Control Data Corporation, have even established their own centres. Most efforts, however, have been cooperative with government and/or educational institutions.

In Canada, a number of different approaches have been taken to date. The Manitoba technology centres are primarily joint federal and provincial government sponsored. The Ontario government, through its 200 million dollar BILD Program, has established six regional technology centres which are completely provincially funded, but have made extensive use of ties to industry through the creation of industrial advisory boards. There are no direct university or educational institution ties to these centres, however, there have been other models created such as the Canadian Institute of Metalworking. This centre was orginally an extension of McMaster University, but is now moving away from the education institution and toward the private sector. It has recently established its own external facilities and some consideration is now being given to its potential privatization. In Quebec, examples have been established on the basis of 100% government funding and control, operating a centre as a crown corporation. In New Brunswick, a joint cooperative venture has been successful between the federal and provincial governments and the universities and community colleges.

There are many differences in the structural and organizational aspects of these facilities and also in their detailed operating mandates, however, all are trying to ensure that new technology is adopted in industry faster and more effectively.

6. b. SOME EXAMPLES TO BUILD ON

More than 20 technology centres have been established across Canada in every province except British Columbia and Prince Edward Island. The structure, mandate, resources, services provided and their local private industry users vary widely. As the initiatives to establish these centres have also come from differing promotion sources with differing sponsors and approaches to funding, they are all quite unique.

There is no technology transfer facility currently in existence, which British Columbia can adopt immediately as a model, that adequately addresses our unique objectives, local concerns and existing resources; however, there is a great deal to be learned from other established centres in Canada.

A review of these centres has resulted in a number of recurring themes being identified which should provide valuable lessons for establishing our own facility in B.C.. A number of these centres also address markets or provide services which are important to B.C. industry, so the structure and organization of these centres is of particular interest.

THE ONTARIO CAD/CAM AND ROBOTICS CENTRE has targeted its activities on small business and has learned the lesson that market development is crucial, but complex. Learning to sell, is important for such a facility and demonstration is a key to bridging the credibility gap.

THE ONTARIO RESOURCE INDUSTRIES CENTRE is of great interest, as a result of British Columbia's large resource industries and resource-driven economy. This Centre has learned the value of cooperation with industry, to increase productivity and the economic health of the

Resource Sector. Product development, leveraging and commercialization have been identified as key activities. Recognition of specialized skills and needs by industry sector, such as mining and forestry, has been proven important with the use of the centre as neutral ground where engineering and purchasing personnel may establish direct cooperation and communication linkages with manufacturing personnel.

THE NEW BRUNSWICK MANUFACTURING TECHNOLOGY CENTRE is an interesting example of cooperation between government, universities, colleges and centre personnel engaged in joint marketing efforts, as well as ongoing assistance to industry. They have adopted a highly proactive stance, recognizing that a reactive posture is simiply not effective - i.e. new technologies must be sold to industry. In addition to the use of demonstration for educational purposes and marketing assistance, they have found the value of creating examples for industry within industry. One of the most effective ways to convince a businessman of the value of a new technology, is to show him how one of his collegues or competitors has actually made money as a result of introducing that technology. This centre also stresses the full use of flow through dollars from federal and provincial programs, essentially packaging and servicing the administration of those programs for industry as required to support centre initiatives.

THE CANADIAN INSTITUTE OF METALWORKING (CIM) in Ontario has demonstrated that CAD/CAM services and centres can be self supporting, especially through training and applied engineering services, but that to achieve this, the larger corporation must be targeted as the primary marketplace for the centre. As their market niche has become larger manufacturing organizations, they have had difficulty, even within Ontario's manufacturing sector, relying strictly on a local market. As a result, they have successfully penetrated the northern U.S.A. markets.

British Columbia's manufacturing sector does not include the large national and multi-national corporations found in relatively large numbers in Ontario, but consists primarly of smaller corporations. If the desire is to serve our local industry with a centre, then government assistance will be required, more in line with the Ontario government's CAD/CAM Centre model and the operating approach of New Brunswick's M.T.C..

Nova Scotia and Newfoundland also have initiatives underway which are of interest, particularly in the areas of offshore development and ocean industries. Due to the terms of reference of the study restricting our efforts primarly toward the forestry, mining and manufacturing sectors, these industries have not been addressed in our study. At this time, offshore development is not a large issue to industry in B.C., however the marine and agriculture industries areas of substantial importance to the B.C. economy and should be addressed in a further study.

6. c. THE MISSION OF A CENTRE IN B.C.

The recommended objectives for the provision of services by a centre for B.C. Industry can be summarized by the following MISSION statement:

> "The B.C. Industry Productivity Services Centre will provide business management and technology support services for the improvement of B.C. Industries' competitive position by increasing productivity through volume growth and optimization of all business resources including material, capital, technology and human resources."

In carrying out this mission, the centre will place priority on:

1. Utilization of existing resources and services in British Columbia and the provision of a focal point and neutral ground for communication and coordination to promote their more effective use by industry.

2. Awareness of benefits and application assistance related to the application of new technologies to products, equipment, processes and total business resource management.

3. Provision of demonstration and familiarization services and facilities emphasizing the application of new technologies required by and related to the specific needs of individual clients and businesses.

4. Effectiveness of human resources at all levels of organization.

Notwithstanding these priorities, the growth of supportive, new technology industries in British Columbia and the establishment of national and international market linkages or distribution networks, can and should be a part of the centre's mission. Focusing, optimizing and promoting volume growth in B.C. industry will help provide employment and encourage the overall growth of the economy.

6. d. MEASUREMENT OF SUCCESS

It is important that methods be developed to measure and evaluate the success of the centre in carrying out its mission. Successes which might be measured would include quantifiable productivity improvements, applications of new technology, launching of new products or volume growth through new markets for established firms, and the establishment of new businesses based on counselling and innovation services.

It is unrealistic at this time to forecast the number of successes which should realistically be achieved within each of these areas in such a manner that they can be directly attributed to the efforts of the centre. However, for budget purposes, some activity objectives should be established. As the centre develops a clear understanding of its clientelle and their relative sophistication, as well as the precise services to be delivered, it will be in a better positon to develop realistic measures of achievement and success.

It is important to recognize that, as the centre operates, there will be a change or evolution of the service mix which it provides to industry. It is necessary as this occurs, to develop new meaningful measures to allow an effective continuing review of the centre's operations and its detailed mandate by the board of directors.

As the centre is intended to be private-sector controlled and eventually self-supporting, the ultimate test of success for the centre will be its ability to generate revenue for its services. However, it will take time for the centre to develop a solid revenue base sufficient for this purpose. It is suggested that a goal be established to recover 90% of operating costs by year five of its operation. The ability of the centre to recover operating costs will be a good measure of the value the centre's clients attribute to its work. The main revenue generators for the centre will be awareness and training workshops, market research, innovation counselling, and applications engineering. If such services are successful, they will recover much of their costs. Other services such as outreach and demonstration are unlikely to recover much of their costs directly. However, services which increase general awareness and effectively promote the expertise and services of the centre to industry are critical to the mandate of the centre.

While not necessarily measures of success, there are several activities which the centre will carry out, the successful completion of which, will help ensure that the original mandate of the centre is preserved and that efforts are directed toward the accomplishment of the defined mission. During the initial five year program of operations, objectives might include the following targets for services to be provided:

6. e. SERVICES TO BE PROVIDED

To carry out its mission, the Productivity and Innovation Centre will provide a wide range of services to address a wide range of B.C. industries' needs. All such services will be aimed at assisting B.C. industry to become more competitive and more productive. These activities will cover:

- promotional and outreach programs
- consulting services
- training, familiarization and demonstration services
- information and referral services

Related to the following specific services identified during the market research and opportunity analysis:

- Business Analysis and Opportunity Identification
- Resource Productivity
- Quality and Reliability
- Product Development Services
- Human Resource Effectiveness
- Information Services

The delivery of these services will vary depending on the specific industry being addressed, their level of awareness and employment of new technologies, and the availability of such services from other facilities or resources.

One of the first operating objectives of the centre must be to establish a database of skills and services available from other resources and service facilities (both public and private sector organizations). The demand for all types of services listed above far exceeds the established service capability. Generally, the service sector is one of the largest employees in the province and already has a substantial wealth of skills and other facilities. For the continued development of these resources and the ultimate good of the industry user/consumers of their services, the centre should not compete with established organizations, but promote cooperation.

It is anticipated that many services requested of the centre could be adequately addressed by referral to another existing facility or service organization. The centre should also develop linkages and working relationships with other service organizations which would allow the centre to package services for clients consisting of a mix of resources from these organizations or in cooperation with centre resources.

The established service organizations in the province (especially private labs, engineering and management consulting firms) should also effectively become client/users of the centre's resources for skill and market development. The permanent staff of the centre would primarily consist of generalists with strong communication, coordination and project management skills. Therefore, a strong relationship with other established service organizations

will be key to the ultimate supply and delivery of highly specialized skills and services.

The development of centre staff and services must emphasize information, an avoidance of duplication, and cooperation to enhance the effectiveness of all resources and facilities through coordination to optimize utilization and service delivery capability.

The services must also be "packaged" to address the needs of industry in a manner which is meaningful to the Centre's clientelle and relate directly to business issues. This has been expanded in the following sections.

6. e. i **Business Analysis and Opportunity Identification**

- Assist in definition of business objectives
- Assist in development of plans and strategies
- Provide market research assistance
- Evaluate volume growth opportunities
- Provide counselling or referral concerning investment capital identification and procurement
- Assistance to present business plans to identified sources of capital
- Provide information or education concerning technology awareness, availability and application capability
- Provide guidance on the competitive utilization of business resources, material equipment and processes, capital, human and time
- Provide effectiveness measurement assistance for human resources including management, professionals and labour
- Provide information, assistance or guidance on;
    - international, national and local industry productivity improvement trends
    - productivity measurements
    - establishment and management of productivity programs

6. e. ii Business Resource Productivity

- provide assistance to determine current productivity levels and cash drains by functional department.

- provide assistance to determine overall management information needs and to implement systems to meet those needs.

- identify productivity improvement opportunities in terms of capital, labour, management and materials by functional area such as:

Engineering	- Value Analysis, Design to Cost, CAD/CAM etc.
Office	- Office automation, electronic mail, etc.
Manufacturing	- Robotics, CAM, Inventory Control, KANBAN techniques, etc.

- assist in identifying technologies and methodologies which will result in significant productivity improvements for the lagging departments in the identified improvement areas.

- assist in the development and implementation of appropriate technologies and methodologies.

6. e. iii Quality & Reliability

- assist in the identificaton of product:
  - specifications
  - standards
  - conformance to specifications and standards

- assist in the understanding of market driven specifications and of communicating those specifications in the engineering, manufacturing, management and marketing departments.

- assist in the implementation of quality control techniques and statistical quality control methodologies, including zero defects techniques and related concepts.

- assist in the identification and implementation of suitable measurement techniques and equipment.

6. e. iv **Product Development Services**
(Including New Technology Development & Application)

- Assisting companies to identify application areas for new technologies in their design, development and manufacturing processes which would lead to significant productivity and quality gains.

- Assist industry in technology sourcing, licencing and/or development

- Providing shared-equipment to companies for product design, development and testing purposes which individually the companies could not justify on a volume basis, but which never-the-less is essential for them to improve productivity and quallity.

- Referral to existing B.C. technology research and development capabilities and facilities

- Providing product design, development and testing services to those companies which lack the technical depth to carry out such work quickly and effectively.

- Assisting companies in rapid engineering bid preparation.

- Provide implementation assistance, information and ongoing trouble-shooting consultation services for the application of specific techniques and technologies.

- Provide access to equipment (under guidance) to help understand and evaluate technologies and techniques.

- Provide testing services through consultation, referral, access to specialized test equipment and test evaluation/measurement.

6. e. v Human Resource Effectiveness

- Provide executive councelling concerning policies, organization and work flow patterns, leadership and team work requirements, compensation and benefits, job security, motivation and awards, and labour relations condusive to greater human resource effectiveness. This counselling should take into account the policies and direction of national and local industry and labcur productivity councils.

- identify the needs and arrange courses, seminars demonstrations and discussion sessions for business management personnel on;

  - business management
  - technology trends
  - development and implementation practices
  - effectiveness of human resource policies, relations and practices

- identify the requirements and arrange for seminars, courses and training of middle management and professionals in the development and implementation of electronic and computer-based technologies aimed at productivity improvement related to their technical and managerial activities responsibilities.

- identify the needs and arrange for training of first line supervisors and prospective candidates for these positions to upgrade their skills of leadership, employee relations and management for more effective utilization of people. Skills addressed here will also include the understanding and application of technologies and procedures condusive to more effective flow of material and operation as well as more reliable and higher quality performance of production processes and equipment.

- identify the needs and arrange for training in the field of CAD/CAM using existing resources and facilities. This includes directing as well as providing advice and feed-back from industry to the organizations on possible course direction/content or needs for new programs and courses.

- organize work shops for:
    - familiarization
    - planning and implementation
    - organizational implications concerning implementation of CAD/CAM systems and other new technologies or equipment

- provide information on internationally competitive standards related to B.C. industry on effective use of human resources. Assist or conduct labour effectiveness studies to determine the difference between local and leading national or international industrial organizations.

6. e. vi Information Services

- maintain library of printed, filmed and audio-visual material relevant to centre activities and B.C. industry

- maintain links into other libraries and banks of information of other productivity and technology centres or research and development organizations

- provide specific information dealing with relevant:
    - local, national and international market data needed to evaluate potential for industry volume growth
    - product, material and production technology innovations and development
    - business resource management technology implementation processes, and operations control
    - technology familiarization and demonstration
    - personnel training and development
    - productivity planning and measurement
    - referrals and other organizations offering services

- issue newsletter containing pertinent information on market opportunity technology, productivity examples and achievement, exhibitions, demonstrations, courses, seminars and workshops to raise awareness for productivity opportunities and stimulate higher rate of achievement.

7. CONCLUSIONS & RECOMMENDATIONS

7. a. ORGANIZATION OF THE CENTRE

7. a. i The Corporate Structure

An original objective of the Western Foundation, which was supported by the EAC and the business leaders interviewed during the market research, was the general principle that the proposed centre be fundamentally controlled and managed by the private sector, ultimately becoming self-supporting. In examining the potential structure and organization, the study team looked at the three following structural options:

A) The Public Agency Model
B) The Foundation Model
C) The Private Corporation Model

Based on discussion with the managers of other centres and the EAC, the study team has concluded that the best model for British Columbia will be that of a private corporation. This model offers the greatest flexibility and helps to encourage:

1) private sector contribution and participation in the centre through share holdings;

2) attracting and maintaining highly skilled senior professionals (it has been recommended that all key personnel be shareholders of the centre);

3) maintaining contact and credibility with industry in the private sector as well as best facilitating staff mobility (i.e. the circulation of skilled individuals through the centre and back to industry for employment and vice versa);

4) maintaining the independence and neutrality required for the centre to operate effectively in an advisory role for government, education institutions, labour and industry;

5) assuring market driven operations and facilitating a profit orientation so that the centre may ultimately become self-sustaining.

The experience of other centres indicates that those that are presently organized as public agencies or foundations both intend to evolve into private corporations. The technology centres in the U.K. that began as public agencies are now corporations. The Ontario technology centres are public agencies with five year sunset clauses, that all intend to be corporations within five years. The New Brunswick centres expressed that if they had it to do it over again, they would start as a corporation.

The chief reason for the public agency and the foundation model is establishing the means of directing public funds towards a business service for a public good. The issues in favour of adopting the public agency or foundation model have more to do with regulations associated with the sources of public funds than the management, promotion and delivery of technology centre services. Guarantees and assurances associated with maintaining responsibility for the disbursement of public funds can be structured into a private sector model through appointments to the boards of directors and in agreements on the issuance of shares.

7. a. ii The Board of Directors

As a close association with industry is mandatory for the effective operation of the centre, it is recommended that a reasonably large board of industrial representatives be created to represent each major industry sector with a vested interest in the operation of the centre. The initial board might be comprised of the following:

1 - Chairman
2 - Mechanical Manufacturers
2 - Electrical and Electronic Manufacturers
2 - Organized Labour
1 - Lumber Industry
1 - Pulp and paper Industry
1 - Coal Mining
1 - Metal Mining
1 - Finance/Venture Capital Industry
1 - Rail Transportation
1 - Air Transportation
1 - National Research Council (exofficio)
1 - Department of Regional Industrial Expansion (exofficio)
1 - B.C. Research (exofficio)
1 - The Discovery Foundation (exofficio)
1 - The Western Foundation for Advanced Industrial Technology (exofficio)

19 - Total (14 voting and 5 exofficio)

Such a board would be well equipped to provide industry input and feedback as well as to develop policies for the provision of business services by the centre. The potential problem of such a large board of directors is that it could easily become somewhat cumbersome and ineffective. It is therefore manadatory that an experienced, effective and dynamic chairman who has the confidence of senior businessmen in British Columbia be selected to lead the board.

7. a. iii Staffing and Organization

The key to the effectiveness of the operation of the centre will lie in the flexibility of its organization and staff. The organizational structure of the centre will be of less importance than its ability to adapt to continually changing project environments. Although permanent staff resources of the centre should be kept to a minimum, emphasizing the use of the best

expertise available for every job (on the basis of sharing resources with existing facilities), there will be a sufficiently large number of permanent positions to necessitate a formal reporting structure for administrative purposes.

It is recommended that the staff be grouped according to the nature of their skills and work into three areas. Essentially the staff will consist of consultants, technicians and educators, plus clerical support. Clerical support can be dispersed throughout the organization, the business consultants should report to the business services manager, the technicians should report to the technical services manager and the human resource consultants and educators should report to the human resource services manager.

All centre personnel must remain sensitive and responsive to the unique needs, personalities and business environments encountered with each new project. An effective matrix management approach must be supported by all of the centre personnel to maximize the utilization of all centre resources on an ongoing basis.

One of the largest ongoing problems and barriers to effective technology transfer, is the credibility gap which exists between the promotor of the new methodologies or technologies and the would be user. This problem can also be addressed better in a project environment where maintaining credibility with the centre's clients can be better facilitated by utilizing the original contact or person on the centre's staff, in whom the client has established confidences as the ongoing manager of the project for that client.

It is anticipated that many of the centres services will be provided by a project team rather than by a specific department within the centre; however, the particular skills and resources within each department will facilitate the delivery of services grouped per the following table:

PRODUCTIVITY & INNOVATION CENTRE SERVICES

Business Services

- Market Identification/ Evaluation
- Business Plan Councelling & Review
- Referrals
- Information Dissimention
- Networking to Other Centres and Facilities
- International Market Linkages
- Gov't Programs, Referrals & Coordination
- Public Outreach, Exhibitions, etc.

Technical Services

- Product Design & Development (Hardware, Software, Mechanical)
- User Facilities for Technology Transfer
- Product Development, Evaluation & Testing
- Needs Analysis
- General Software & Equipment Access
- Software & Equipment Demonstration Trouble Shooting & Post Installation Services
- Bid Preparation
- Technology Evaluation & Cost/Benefit Analysis

Human Resources

- Human Resources Counselling
- Management Courses
- Executive Awareness of Benefits/Value
- Seminars for Supervisors & Technical People
- Labour Awareness Counselling
- Shop Floor & In House Technical Training

7. a. iv Senior Management

One of the key items of advice given the study team by senior officials of the larger corporations (interviewed during the market research) and by the managers of the other established technology centres, was that a strong individual be found to operate as the president of the centre. This role was specified as higher level marketing and promotion of the centre and its services. This is a key capability which will effectively make or break the initiative by setting the tone and industry's perception of the Centre and its operation. The individual who is selected for this position must have excellent connections within industry, government and education (areas key to the operation of the centre). He should also be highly skilled in corporate communications and public relations, and be able to effectively coordinate the industry and other groups which must work together to make the centre a success. It is envisioned that this individual will require a senior executive assistant and will not be involved in the day-to-day administration of the centre.

Reporting to the president should be a vice-president of operations and general manager who will be responsible for the detailed operation and administration of the centre. This individual should be conversant with business and the new technologies, but above all, be an effective administrator capable of dealing directly with technical people as well as senior business executives. He should be skilled in the management of highly volatile resources with a high rate of turnover and dependency on joint ventures or subcontracting.

Reporting to this individual, would be managers for each of the three key staff resource groups and service areas identified. These management positions have been identified as follows:

1) Vice-President Business Services
2) Vice-President Technical Services
3) Vice-President Human Resource Services.

The individuals selected for these three positions must be highly skilled in administration as well as the application of the particular services for which their department is responsible. They will all operate as hands-on technicians in the delivery of their department's services and will operate with a small core of staff who tend to be very senior consultants or highly specialized technicians. The administrative skills of these managers will be of the utmost importance as each department will rely heavily on working with industry and other existing facilities and resources for the actual delivery of their services.

7. a. v Industry and Labour Working Committees

It is further recommended that each department work with industry working committees in varying forms. Human resource services should work with a joint industry labour reference committee. Technical services should operate with a number of industry working committees which are related to the industry sectors for which services will be performed. As an example, transportation, forestry and mining would all have their own industry working committees.

These committees would essentially involve consumers with problems and needs working directly with the innovators and developers of products. This will help ensure that product development is matched to real industry needs. The committees will also be invaluable in opportunity identification and the provision of research and development advice. It is recommended that representatives be appointed to each committee from senior management positions. Essentially each committee would consist of buyers and sellers, with the buyer group consisting of engineering and purchasing managers, and the seller group consisting of manufacturers and service industry representatives.

7. a. vi Planning to Establish the Centre

Another key item of advice given the study team by managers of established centres, was that the actual establishment of a centre is a lengthy and

difficult exercise for a newly recruited manager to embark on. Most centres in the past have been established beginning with the recruitment of a new manager who was then charged, essentially by himself, to recruit the balance of his staff and establish the centre. Individuals placed in this situation have found their own education to be a problem with regard to their marketplace and precise mandate for operations.

The right people for these jobs are difficult to find and the new managers have been frustrated by the fact that it takes a long time to educate their new recruits. The tendency in view of the fact these services are so dependent on the skills of their people, is to refine their operating mandate giving recognition to the personalities and precise skills of the people who they hire. This problem is compounded as all the people who are effectively "new to the job" must reach out and explore their marketplace. Their tendency is to further modify the mandate of the centre to match the market which the staff succeed in identifying or creating.

The bottom line to the advice here is that the marketplace for the centre should be clearly understood; the mandate for the centre should be agreed upon; and continuity from the stage at which these points are agreed, should be maintained throughout the establishment of the centre (recognizing that it takes time to get the right people for the job and to effectively commence operation of the centre). For these reasons, the study team is recommending that a turnkey approach be adopted to staff the centre and commence its operations. This process could be assisted greatly if the members of the existing EAC could be retained as the initial board of directors for the centre.

In summary, a recommended course of action for the establishment of the centre would proceed as follows:

1) Incorporate and create a board of directors of industry representatives where each member gets a share or shares in the centre.

2) Develop and promote a funding request to the federal government for the initial capital required to setup the centre and assure its operations for three to five years.

3) Establish a turnkey management group who will be charged with the actual creation of the centre, its initial operations and the recruitment of permanent staff (operating under the direction of the board).

4) Develop a share participation plan for centre staff, as they are recruited, give shares and/or options to all key employees.

5) Promote widespread participation in the centre by industry through the offering of shares and/or memberships. This and specific private placement initiatives will assist in funding the centre and increase private sector involvement, thereby increasing the assurance of the centre's ultimate success and viability.

7. b. FUNDING REQUIREMENTS & BUDGET OUTLINE

7. b. i Capital and Equipment

As was previously outlined in the conclusions from the market research, it is recommended that this centre should not initially make large capital investments in current state of the art equipment for the purposes of large volume contract services and shared access. The emphasis should be placed on software and soft services, utilizing most equipment initially for demonstration and awareness purposes. The budget outline which follows (see figure 7.b. i-1) does not make any initial provisions for robotics or elaborate test and CNC equipment.

As operations become better established, there will be modest requirement for such resources to facilitate demonstration and the general promotion of awareness of benefits. The initial capital investment must emphasize computing capabilities for software, information and library services placing

emphasis on communications, access to existing resources and personal computing for business, as well as the establishment of the basic resources which will be required in daily operation of the centre to promote its services.

Provisions have been made to establish "satellite" links or centres with B. C. community colleges, universities and research facilities. These "satellites" would involve terminals to provide remote access to the library and data bases developed by the centre.

A modest investment should also be made immediately made in CAD/CAM technology emphasizing CAD and smaller stand-alone systems in particular. The demonstration equipment should be within the price range that potential users may be able to afford shortly or under more optimistic growth prospects. The experience of other centres has shown that the first year of operation can be expected to be largely promotional and demonstration oriented, with hard services only being required later in the first year or the beginning of the second year. For this reason, a basic demonstration capability of diagnostic and test equipment as well as NC/CNC machines and robotics will be necessary.

Throughout the second and potentially into the third year of operation, the centre's operating objectives will likely remain largely dedicated to increasing the awareness of new technologies and the competence of the would-be buyers and implementers of these technologies.

As time goes on, it is expected that the market place for centre services will change and the service mix offered by the centre must evolve to match the requirements of that market. As business succeeds in implementing new technologies there will be a requirement for more software development capability related to tailoring software to the needs of individual business users. In recognition of these needs there will be an increased requirement for robotics and CNC investment at the centre for the purpose of developing and testing new software.

CAPITAL EXPENSE BUDGET

(All Figures in Thousands of Dollars)

(Figure 7.b.i-1)

EQUIPMENT & SOFTWARE	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
MINI-MAINFRAME HOST	400.0	100.0	100.0				600.0
CAD/CAM WORKSTATIONS	300.0	150.0					450.0
P/C'S & OTHER TERMINALS	120.0	30.0	30.0	10.0	10.0		200.0
PLOTTERS	30.0	50.0					80.0
DIGITIZERS	5.0	5.0					10.0
MISC. PRINTERS	15.0	8.0	8.0				31.0
PRODUCTION CONTROL EQUIP.	100.0	100.0	50.0	20.0	20.0	10.0	300.0
DIAGNOSTIC & TEST EQUIP.		100.0	100.0	20.0	20.0	10.0	250.0
ROBOTICS		150.0		150.0			300.0
NC/CNC MACHINES		100.0		100.0			200.0
PHOTOCOPY, BINDING, ETC.	30.0						30.0
SATELLITE CTR. & HDW & SFTW	150.0	50.0					200.0
HOST O/S & ENG. APPL'NS	100.0	50.0					150.0
P/C ENG. APPL'N SOFTWARE	30.0	50.0	50.0				130.0
BUSINESS & OTHER SOFTWARE	50.0	50.0	50.0	50.0	50.0	30.0	280.0
SUB-TOTAL :	1,330.0	993.0	388.0	350.0	100.0	50.0	3,211.0
LEASEHOLD/SUPPORT EQUIP.	150.0	100.0					250.0
TOTAL :	1,480.0	1,093.0	388.0	350.0	100.0	50.0	3,461.0
CUMULATIVE :	1,480.0	2,573.0	2,961.0	3,311.0	3,411.0	3,461.0	

Aside of these basic objectives and the overall requirement to remain current with new technologies (necessitating smaller ongoing expenditures), the centre must continue to develop and build on linkages, relationships and partnerships with existing facilities and resources. It should endeavour to maximize the utilization of a very large investment in test equipment, robotics and NC/CNC machines which is already in place at a number of educational institutions and certain establishments within the private sector.

The $3.6 million which has been outlined here for all software, equipment and services is very small in relation to the provisions at many of the other established Canadian centres. Within the Ontario CAD/CAM and Robotics centre the CAD/CAM department alone, was created with an initial capital budget of $7.6 million and the Manufacturing Technology Centre in New Brunswick has budgeted for $12 million in equipment.

However, the market research demonstrated that there is a large investment in new technologies and equipment in place in British Columbia which is being sorely under utilized. The overall objective of this centre and its mission as recommended by the study team, does not necessitate such large new investments, but rather must promote increased productivity from existing resources. This will be achieved by having the centre provide co-ordination, referral and access services channelling industry needs to those established facilities which can best satisfy the specific needs of the individual client being dealt with at the centre.

Many other centres have found over time, or have even budgeted initially for the acquisition or development of their own buildings and specialized facilities. However, the contention of the study team is that the emphasis of a centre in B.C. must be on software and soft services, and that the promotion of productivity and innovation itself does not require "bricks and mortar." If, over time, this centre finds that it requires or would benefit from such facilities, then options for the establishment of the facilities should be addressed at that time. This should not be a consideration for at least the first three years of operation.

7. b. ii Staff Resources

As was outlined in the previous section of the report, the best way to ensure a continuity from this study through to the establishment of an effective working centre, would be to commence its operations immediately under the direction of the board of directors and employing the services of a turnkey management consulting group. It is anticipated that the promotion and general awareness services could be started almost immediately, as the basic equipment and resources are put into place with a minimal staff of consultant engineers, technicians and secretarial or clerical assistance. This staff resource base can then develop under the direction of the turnkey management group and the board as the middle level or department managers are found and put into place.

The search for the right president and general manager should be careful and deliberate ensuring that the best possible people are selected for these positions. The search and the education of the individuals ultimately selected will very likely be a rather lengthy exercise. It is imperative, as this process continues, that the focus and mission of the centre be understood and preserved, ensuring that the true critical needs of B.C. industry as identified by the market research are in fact addressed. Once the centre is operating effectively in line with these objectives, its services can then be allowed to evolve as the market place for the centre services and the needs of B.C. industry actually change.

The core organization envisaged here involves only ten general consultants with a minimal support staff of six technicans to participate in actual demonstration of technologies and special services such as software development. The president, secretarial and clerical staff would bring the total staff resources of this centre to twenty-two. Figure 7.b.ii-1 identifies a feasible staffing plan, as well as potential start salaries assumed to be reasonable in current market conditions. In view of the current economic conditions and trends, it has been assumed that modest annual salary increases and provisions for benefits would be sufficient to attract the staff required.

STAFF/MANPOWER BUDGET

(Salary Figures in Thousands of Dollars)

(Figure 7.b.ii-1)

START SAL/POSITIONS	SALARY	1984	1985	1986	1987	1988	1989
PRESIDENT	90			1	1	1	1
V.P./GENERAL MANAGER	84			1	1	1	1
V.P./DEPT. MANAGER(S)	72		3	3	3	3	3
CONSULTANTS (ENG./ED.)	50	3	4	5	6	6	6
TECHNICIANS	35	2	4	5	6	6	6
SEC./CLERICAL	18	2	3	5	5	5	5
TOTAL STAFF:		7	14	20	22	22	22
MGR'S SAL. INC. (%/YR) =					5	5	5
OTHER SAL. INC. (%/YR) =			5	5	5	5	5
BENEFITS (% GROSS) =		12	12	12	12	12	12
OPER. MONTHS IN 1984 =	6						

SALARIES & BENEFITS	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
PRESIDENT			90.00	94.50	99.23	52.09	335.82
V.P./GENERAL MGR.			84.00	88.20	92.61	48.62	313.43
V.P./DEPT. MANAGER(S)		216.00	216.80	226.80	238.14	125.02	1,021.96
CONSULTANTS (ENG./ED.)	75.00	210.00	275.00	347.29	364.65	191.44	1,464.01
TECHNICIANS	35.00	147.00	192.94	243.10	255.26	134.01	1,007.30
SEC./CLERICAL	18.00	56.70	99.23	104.19	109.40	57.43	444.94
TOTAL SALARIES :	128.00	629.70	957.79	1,104.08	1,159.28	608.62	4,587.46
BENEFITS @ 12% :	15.36	75.56	114.93	132.49	139.11	73.03	550.50
TOTAL SALARIES & BEN :	143.36	705.26	1,072.72	1,236.56	1,298.39	681.66	5,137.96
CUMULATIVE :	143.36	848.62	1,921.35	3,157.92	4,456.30	5,137.96	

As recommended earlier, the incentive which should ensure that superior personnel can be attracted and maintained would be the offer of share participation in the private corporation, which could well become a profitable venture by its fifth or sixth year of operation.

7. b. iii General Operating Expenses

The suggested operating budget for the centre has been broken into three sections for general operations, pure technical data centre operations and sub-contracts (see figure 7.b.iii-1). The turn-key management consulting contract has been shown under the latter category anticipating an intensive effort for the first twelve to eighteen months and then a gradual phasing out over a following eighteen month period. This should allow adequate time to put the capital equipment and staffing organization into place as well as ensure that the mission of the centre is preserved with continuity maintained from this study through to the time when the centre personnel, as a working cohesive group, can react with its board of directors to its own evolving client base.

As discussed earlier in the report, it is recommended that the centre should endeavour to identify and utilize the best possible resources from the local and international market place to address the consulting and educational needs of industry in B.C.. Provision has therefore been made for a substantial ongoing budget for sub-contracted resources.

The costs outlined under Data Centre Operations pertain to the ongoing operation of the equipment to be maintained at the technical data centre. This includes general supplies as well as equipment and software installation and maintenance service contracts with suppliers, but also anticipates reasonably substantial communications, line charges and outside processing services. This will be necessary if the centre is to utilize the software and equipment resources of other facilities for information services as well as specialized application services employing highly specialized skills, software or equipment.

OPERATING BUDGET

(All Figures in Thousands of Dollars)

(Figure 7.b.iii-1)

GENERAL OPERATIONS	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
OFFICE RENT	30	60	80	100	100	50	420
FURNISHINGS & LEASEHOLD	80	20	40	40			180
UTILITIES	20	45	50	55	60	30	260
SUPPLIES & OFFICE EXPENSE	50	100	100	100	100	50	500
TRAVEL	30	80	90	80	80	40	400
INSURANCE	20	40	50	55	60	30	255
TRAINING & EDUCATION	20	40	40	40	40	20	200
ADVERTISING & PROMOTION	60	150	100	100	100	50	560
RECRUITMENT & RELOCATION	100	50	50				200
LIBRARY	50	150	150	150	150	75	725
SUB-TOTAL :	460	735	750	720	690	345	3,700
DATA CENTRE							
EQUIPMENT INST. & MAINT.	20	25	30	34	36	19	164
SOFTWARE INST. & MAINT.	5	3	4	4	5	3	24
COMM. LINE CHARGES	6	12	15	15	15	8	71
PROCESSING SERVICES	10	20	30	35	40	20	155
MAINFRAME SOFTWARE LIC.	150	350	400	400	400	200	1,900
SATELLITE CTR. LINES & MAINT.	10	20	20	20	20	10	100
SUPPLIES	20	50	60	60	70	35	295
SUB-TOTAL :	221	478	557	566	583	293	2,698
SUB-CONTRACTS							
TURNKEY MANAGEMENT FEES	200	400	250	100			950
EDUCATION & CONSULTING	50	250	250	250	250	125	1,175
TOTAL OPERATING BUDGET :	931	1,863	1,807	1,636	1,523	763	8,523

All other operating costs have been grouped under general operations. Modest provision has been made for office rentals, furnishings and leasehold, utilities, supplies and office expense, travel and insurance. It should be noted that centre personnel must themselves remain current with the latest in new methodologies and technologies, so a budget provision must be made for ongoing training and education. A provision has been made for recruitment and relocation expenses to staff the centre. A substantial allocation will be required for advertising and promotion on an ongoing basis, with particularly heavy expenditure in the first twelve to eighteen months of operation. The largest single expenditure area of ongoing operations will be the development and maintenance of an extensive library and system for cross-referencing, locating and accessing the data which it contains.

7. b. iv Revenue Potential

Based on the market research and discussions with other established centres, it seems to be reasonable to expect that the centre can generate revenue for its services as outlined in figure 7.b.iv-1. This table illustrates revenue potential by operating department within the centre. Note that the business services department within the centre will actually have a number of distinct sources for revenue and that revenues will initially be quite low as an investment must be made in general promotion and awareness for which very little of the costs are likely to be recovered.

As these initial efforts create an increased awareness within B.C. industry, the revenue potential of the centre will increase rapidly. Other centres have found that the first six to twelve months of operation must be largely an investment in promotion and awareness and that, following this start-up period, it appears reasonable to expect that a revenue base of approximately $1,000,000 per annum can be built from these services (with the recommended staff resources) over a one to two year period. As the centre's client base continues to develop, the centre should be able to build a solid and increasing revenue base of recurring services for technical and human resource consulting. The table therefore illustrates very rapid revenue growth through the first three years, as the organization is established and

REVENUE PROJECTION

(All Figures in Thousands of Dollars)

(Figure 7.b.iv-1)

REVENUE SOURCE	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
BUSINESS SERVICES :							
SEMINARS & CONFERENCES	40.0	100.0	115.0	130.0	135.0	70.0	590.0
NEWSLETTERS/MEMBERSHIPS	10.0	25.0	40.0	60.0	70.0	40.0	245.0
COUNSELLING/INNOVATION	10.0	50.0	55.0	60.0	70.0	40.0	285.0
MARKET RESEARCH		20.0	30.0	40.0	50.0	30.0	170.0
INFORMATION SERVICES	5.0	10.0	20.0	40.0	50.0	30.0	155.0
	65.0	205.0	260.0	330.0	375.0	210.0	1,445.0
HUMAN RESOURCE SERVICES :		100.0	150.0	200.0	250.0	150.0	850.0
TECHNICAL SERVICES :	20.0	150.0	300.0	500.0	750.0	500.0	2,220.0
TOTAL REVENUE :	85.0	455.0	710.0	1,030.0	1,375.0	860.0	4,515.0
ANNUAL REVENUE INCREASE :		$285	$255	$320	$345	$345	
		168%	56%	45%	33%	25%	

matures within its market place. Healthy growth of the revenue base should continue in the ongoing years, but likely at a somewhat reduced rate.

On this basis, the centre would be approximately 65 - 70% self-supporting by the fifth year of its operation. Other centres have suggested that a reasonable objective should be 50% self-supporting by the fifth year, however the study team feels that it is practical to accelerate these objectives within the B.C. market place and furthermore, that the centre can and should become self-supporting by its sixth or seventh year of operation.

7. b. v Funding Requirements

A summary has been created to illustrate the external funding requirements to establish and operate the centre based on the expenditures and revenue projections detailed in the preceding sections 7.b.i through 7.b.iv. The total cost of the centre as outlined here is approximately $15.3 million, over five years with a revenue potential of $4.5 million over that period. This results in a net requirement for $10.8 million in additional funds. A table detailing these funding requirements by operating year has been included as figure 7.b.v-1.

For the sake of simplicity and expediency, the study team has recommended that a single request for funding should be addressed to the federal government for a combination of funds from the National Research Council (NRC) and the Department of Regional Industrial Expansion (DRIE). The funding requirements for each year as outlined have been rounded upward to provide for a small surplus or contingency. The contingencies illustrated actually amount to less than 5% each year. In normal business planning, a contingency of at least 15% should exist. However, such a contingency should not be built with public funds.

The objective in developing the ultimate funding request should be to keep that request to an absolute minimum which is sufficient to ensure that the mission and objectives of the centre can be met with reasonable certainty for a period of three to five years.

FUNDING REQUIREMENTS

(All Figures in Thousands of Dollars)

(Figure 7.b.v-1)

REVENUE	(6 mo) 1984	1985	1986	1987	1988	(6 mo) 1989	(5 yr) TOTAL
EXTERNAL FUNDING	2,500.0	3,220.0	2,570.0	2,210.0	1,560.0	650.0	12,710.0
CENTRE REVENUE	85.0	455.0	710.0	1,030.0	1,375.0	860.0	4,515.0
TOTAL REVENUE :	2,585.0	3,675.0	3,280.0	3,240.0	2,935.0	1,510.0	17,225.0
EXPENDITURE							
SALARIES & BENEFITS	143.4	705.3	1,072.7	1,236.6	1,298.4	681.7	5,138.0
OTHER OPERATING	931.0	1,863.0	1,807.0	1,636.0	1,523.0	763.0	8,523.0
SUB-TOTAL:	1,074.4	2,568.3	2,879.7	2,872.6	2,821.4	1,444.7	13,661.0
CAPITAL EXPENSE	1,480.0	1,093.0	388.0	350.0	100.0	50.0	3,461.0
TOTAL EXPENSES :	2,554.4	3,661.3	3,267.7	3,222.6	2,921.4	1,494.7	17,122.0
CONTINGENCY :	30.6	13.7	12,3	17.4	13.6	15.3	103.0

The practical experience of other established centres has shown that this is a realistic maximum period of time which can be planned, so many of the centres have been created with business plans including a "sunset clause" at the end of year five of their operations. A review of the experience of other centres has also shown that the centre's market will evolve and, as the service mix changes to suit the needs of its market place, the study team feels that this factor should be subject to a continuing review of its mandate and usefullness via its board of directors. The authorities responsible for and providing this external funding should participate in this review (see sections 6.c. & 6.d. - "The Mission of a Centre in B.C." and "Measurement of Success").

APPENDICES

APPENDIX A
RESEARCH INFORMATION

A. i ESTABLISHED RESOURCES & FACILITIES IN B.C.

1) Universities, Colleges & Technical Institutes

THE UNIVERSITY OF BRITISH COLUMBIA has established a new microelectronics centre within the Electronic Engineering Faculty funded through the federal "Centres of Excellence" program with a grant of one million dollars over five years. The University also has a robotics program in place, with their own robot, as well as a CAD/CAM program with their own CAD system and C.N.C. machining centre. They are in the process of developing a CAD/CAM and robotics team and have been doing C.N.C. machining for some time, so have succeeded in establishing, and will continue to develop, a group of considerable expertise.

SIMON FRASER UNIVERSITY has a new engineering program teaching CAD/CAM as a one year course within their engineering curiculum. They have a joint program in place with AEL Microtel Pacific Research in custom chip design and manufacturing.

S.F.U.'s Energy Research Institute also provides a range of relavent services and currently has an interesting project in process which has been funded by a large contract with the Federal Department of Energy Mines and Resources. The University also conducts research in biotechnology which has recently included a project funded with a grant from the Science Council of British Columbia.

THE UNIVERSITY OF VICTORIA has recently made a number of announcements concerning its new Faculty of Engineering. A director of CAD/CAM and Robotics has recently been appointed and an appointment is pending for a new director of the VLSI Technology Unit. The new program will initially use a Charles River computer system to be replaced by a new system which will be selected early in 1984. Meanwhile, tenders have been called for a twenty-eight thousand square foot extension to the Sciences and Engineering Building scheduled for

1) Universities, Colleges & Technical Institutes (continued)

completion in two years. Existing facilities will then be turned over to a new mechanical Engineering Program. The engineering program at the university features a co-op plan through which students spend approximately half their time in industry gaining practical work experience. The Co-Op Program includes the Computer Sciences Faculty and received a strong endorsement from private industry.

THE BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY is offering a number of regular programs aimed at training technologists as well as a series of courses on CAD/CAM through their division of continuing education. B.C.I.T. continues to monitor their course programs with panels of industry representatives and in response to the new technologies, they are currently developing a new high technology program providing training in CAD, Robotics and Micro-electronics. This program will be offered from a new centre housed in a building currently under construction and scheduled to be opened in September 1984.

THE PACIFIC VOCATIONAL INSTITUTE also has a new computer aided design and drafting centre under construction. Their programs will be aimed at training operators for new technology equipment.

KWANTLEN COLLEGE has recently established their technology centre at the Neuton Campus in Surrey, B.C.. This facility was established in the fall of 1983 with the aid of a 5.4 million dollar Federal Government Skills Growth Fund Grant. Their programs are aimed at training technologists in designated high priority occupations. At this time programs are in place for Computer Information Systems Technology and Electronics and Electrical Engineering Technology. Their schedules for next fall include programs in Civil Engineering Technology, Computer Control Technology and Industrial and Mechanical Engineering Technologies.

1) Universities, Colleges & Technical Institutes (continued)

THE COLLEGE OF NEW CALEDONIA in Prince George has recently opened their new CAD/CAM centre which will operate separate from the College as the Nortern Technology Centre. This was funded with 2.8 million dollars from the Federal Government Skills Growth Fund. C.N.C. has also announced the founding of a new research organization - The Northern Institute for Resource Studies. The CAD/CAM centre and institute will work with the forestry and mining industries in the northern part of the province.

MALASPINA COLLEGE in Nanaimo, B.C. has also established a CADD training program for their Fast Track Training Division.

It should be noted, that all Federal Government monies and Provincial Ministry of Education funding, is tied to the provision of course hours within the "occupations of designated national importance". The College of New Caledonia, however, has established a service centre for industry through the creation of The Northern Insitute and has effectively taken Skills Growth money and redirected it through the college to industry. Other colleges should examine this example regarding access and service to industry for the lower mainland.

C.N.C is also proposing an expansion to the facilities of the Northern Institute with a 20 million dollar project to support advanced technological needs within the forestry and mining industries in northern B.C.. The Centre proposed in this report must assist industry in the lower mainland, island and southern interior in accessing and marketing services available from C.N.C. as well as promote, inform and assist private industries' access to the services available through existing resources in the southern areas of the province. The responsibility for such services to industry in the northern interior of B.C. should rest with the Northern Institute.

All the Educational Institutions have recognized the importance, and the difficultly they face, in dealing effectively with industry in the private

1) Universities, Colleges & Technical Institutes (continued)

sector. A number of initiatives have been taken to improve relations with industry and cooperative efforts between the institutions. The University of British Columbia's business school has established an industrial services group which provides access for the business community and marketing assistance. U.B.C. is also moving their microelectronics centre out of the university to the Discovery Parks adjacent to B.C.I.T.. C.N.C., U.VIC. and P.V.I. in particular, have established linkage mechanisms for sharing information amongst themselves concerning high technology, CAD/CAM and the programs they provide. Many of the facilities mentioned above, have substantial equipment resources for CAD/CAM, machining and electronic testing. This equipment, plus the established technical expertise, represents a substantial resource for industry to tap, yet there is no practical access mechanism for industry at large to make use of these resources.

There are a number of interests to be acknowledged and protected here. The Ministry wants grads with technical certificates. The schools wish to expose students from all disciplines to the new technologies. Industry wants practical retraining for skilled and experienced personnel. A point which must be recognized, is that these are compatible ideas. The education institutions are providing well for the longer term, but the centre must address the immediate needs of industry. By cooperating with these institutions, the centre will effectively support this public investment. The centre will serve the private sector by addressing some of the short term needs of industry. It will also increase the awareness in industry of the benefits of the new technologies and, thereby encourage the implimentation of these technologies in industry. This in turn will effectively help to create the jobs for the future graduates of these institutions.

2) Government Programs & Agencies

A number of programs and agencies have been created by the Federal and Provincial Governments which can be of assistance to industry in these matters. Some of the key resources available locally are:

THE B.C. DISCOVERY FOUNDATION is a nonprofit society which provides seed capital loans under the Discovery Enterprise program to assist the commercialization of B.C. technology. It operates four R&D Discovery Parks adjacent to major B.C. universities.

THE SCIENCE COUNCIL OF BRITISH COLUMBIA provides direct finanacial grants, as a nonprofit society, to scientists and researchers at unversities and private companies, to support new technology development.

B.C. RESEARCH is a technical research institute of the B.C. Research Council, is a nonprofit society that conducts research, development and other technical work in applied biology, chemistry, engineering, physics and management.

FORINTEK CANADA CORPORATION is a private nonprofit corporation which directs its efforts to basic and applied research. All major scientific and technical disciplines related to wood products are addressed. The Western Division is located at the University of British Columbia.

THE FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA (FERIC) is supported by industry and government with research activities in harvesting machines and systems, human factors, transportation, environment and wood utilization. They currently spend one million dollars per year on B.C. Western Division research projects.

THE PULP AND PAPER RESEARCH INSTITUTE OF CANADA (PAPRICAN) is a nonprofit research and educational institution which conducts

2) Government Programs & Agencies (continued)

research for industry members and government. It has a forty million dollar annual budget for research projects and supports the new UBC pulp and paper centre as well as the new Pulp and Paper Research Institute.

THE NATIONAL RESEARCH COUNCIL'S WESTERN LABORATORY conducts research and development in CAD/CAM tribology, or wear materials, and the applications of the technology. They have a substantial facility with a McAuto CAD/CAM system and a two and a half access milling machine, and do advanced work with direct numerical control (DNC).

THE NATIONAL RESEARCH COUNCIL also has a series of programs to help promote industrial research in Canada and to provide financial assistance to manufacturing companies for applied research. These programs are known collectively as the:

INDUSTRIAL RESEARCH ASSISTANCE PROGRAM (IRAP) this includes a field advisory and technical information service, plus four special contribution programs:

IRAP-H: for small and medium sized companies to help solve short-term scientific, engineering and technological problems.

IRAP-L: for small and medium sized companies to help with technical problems or testing requirements associated with their products or processes.

IRAP-M: for longer term projects (up to a year in length) to encourage research and development in small companies which have limited or no technical staff.

2) Government Programs & Agencies (continued)

IRAP-P: for longer term applied industrial research projects of high technical merit.

The NRC's B.C. Industrial Services division has also indicated a willingness to negotiate NRC support for provision of technical personnel to the centre, as well as co-operative marketing of IRAP programs through centre staff.

THE FEDERAL BUSINESS DEVELOPMENT BANK has 17 regional offices in the province which offer case counciling and management seminars on a local basis. Since the fall of 1983, this agency has been charged with the primary responsibility for marketing and promoting all federal government programs to industry. This includes the following programs and information:

1) Industrial Regional Development Programs (IRDP)
for the Department of Regional Industrial Expansion (DREE).

2) Industrial Research Assistance Program (IRAP)
for the National Research Council (NRC).

3) Sourcing and Bidding Information
for the Department of Supply and Services (DSS).

A major computer program is currently under development to index and access all of the information. Discussion with the Management Services Director of F.B.D.B. in B.C. has led to agreement that a terminal accessing this system should be installed in the centre.

OTHER B.C. GOVERNMENT PROGRAMS of interest include the B.C. Ministry of Labour Vocational Rehabiliation service and the High Tech Program under Summer Youth Employment. The province also provides a number of financial aid and incentive programs to industry related to

2) Government Programs & Agencies (continued)

new product development and capital equipment aquisition. the major programs are:

- Low Interest Financial Today (LIFT), low interest loan assistance offered to B.C. companies at four points below B.C.D.C. prime. This program is administered by the British Columbia Development Corporation.

- Discovery Enterprise Program, administered by the Discovery Foundation, provides loan assistance to high-technology companies seeking to establish themselves or to expand the technology based product range of existing companies.

- Science Council of British Columbia offers R & D grants to assist industry in the development of new products and processes often in cooperation with B.C. Research or the universities.

- Ministry of Industry & Small Business Development provides small grants to assist industry in market or technological feasibility studies.

THE DEPARTMENT OF REGIONAL INDUSTRIAL EXPANSION (DRIE) has a number of programs to assist business in various aspects of growth and development including the following:

The PROGRAM FOR EXPORT MARKET DEVELOPMENT (PEMD)

A series of programs to assist businesses in the development of new international markets for exporting their products and/or services.

2) Government Programs & Agencies (continued)

The DEFENSE INDUSTRY PRODUCTION PROGRAM (DIPP)

A series of programs comprising the largest single source for private sector capital to buy new technology.

The INDUSTRIAL REGIONAL DEVELOPMENT PROGRAM (IRDP)

A wide range of programs for product development, marketing, production and export.

OTHER FEDERAL GOVERNMENT PROGRAMS exist to assist business in a number of areas relevant to the Centre's objectives. These include the Canada Works Program, which helps to find new jobs in high technology; the Canada Energy Resources Research Fund, which focuses on renewable energy resource activities; the Canada Institute for Scientific and Technical Information (CISTI), which develops and maintains a number of data bases for scientific and technical information; and numerous other resources.

3) Private Sector Service Organizations

Within the private sector in British Columbia, there already exists a substantial wealth of expertise and hard resources for accessing or utilizing the new technologies. Generally, these organizations include:

- ENGINEERING CONSULTING FIRMS,
- HUMAN RESOURCE & MANAGEMENT CONSULTANTS,
- COMPUTER SYSTEMS CONSULTANTS,
- EQUIPMENT & SOFTWARE VENDORS.
- PRIVATE LABS

With a slightly different slant on the operations of these firms, the centre can assist potential industry users in tapping the further potential of these service organizations, assist the service organizations in marketing, and act as a coordinator addressing needs of the private corporations who will be the client/users.

4) Sources of Private Sector Capital

Quite often the final barrier to the adoption of new technology in industry becomes a question of capital. However, there are a substantial number of resources available to B.C. industry. These include conventional lending institutions, venture capitalists and individual seed capital investors. There are also the Federal Business Development Bank's Equity Finance Division, the Discovery Enterprise Fund and the LIFT programs, as well as trust companies' pension funds and insurance corporations which provide for a portion of risk investment in their portfolios. New legislation was recently introduced, and is expected to be passed into law early in 1984, to provide federal tax credits for research and development. The R&D tax credit/incentive system has been greatly simplified and can be of substantial value directly to the corporation, or as an incentive to potential investors in the corporation.

A. iii Contacts Interviewed at Canadian National CAD/CAM Meeting

John Richardson
OCAM-ONTARIO CAD/CAM CENTRE
Cambridge, Ontario

Joe Harrison
GROSS MACHINERY GROUP
Ottawa, Ontario

Shannon Kyles
CANADIAN INSTITUTE of METALWORKING
Hamilton, Ontario

B. Teece
DEPT. COMMERCE & DEVELOPMENT
Fredericton, New Brunswick

Dave Bonham
UNIVERSITY OF NEW BRUNSWICK
Fredericton, New Brunswick

Jack Scrimgeour
NATIONAL RESEARCH COUNCIL
Ottawa, Ontario

Gordon Pierce
SASKATCHEWAN RESEARCH COUNCIL
Saskatoon, Saskatchewan

Lynn Pammett
NOVA SCOTIA DEPT. OF DEVELOPMENT
Halifax, Nova Scotia

Ted Crozier
CANADIAN INSTITUTE of METALWORKING
Hamilton, Ontario

Victor Landry
DREE/ITC
Moncton, N.B.

Cec Archibald
NATIONAL CASH REGISTER
Manufacturing Division
Waterloo, Ontario

Andrew Perejoa
ICAM TECHNOLOGIES
Pointe Claire, Quebec

Bill Durant
OCAM -ONTARIO ROBOTICS CENTRE
Peterborough, Ontario

W.C. McGregor
DEPT. COMMERCE & DEVELOPMENT
Fredericton, N.B.

Jack Dickinson
UNIVERSITY OF WESTERN ONTARIO
London, Ontario

Roland A. Dugre
MINISTRY SCIENCE & TECHNOLOGY
Montreal, Quebec

Jim Reichert
MANITOBA RESEARCH COUNCIL
Winnipeg, Manitoba

Jim Mozel
UNIVERSITY OF REGINA
Regina, Saskatchewan

Aftab Mufti
TECH. UNIVERSITY OF NOVA SCOTIA
Halifax, Nova Scotia

Dave King
DREE/ITC NEWFOUNDLAND
St. John's, Newfoundland

Louis Giroux
OFFICE OF INDUSTRIAL INNOVATION
Government of Canada
Ottawa, Ontario

APPENDIX B
B.C. STUDY MATERIAL BACKGROUND

B. i The Study Team

The Western Foundation for Advanced Industrial Technology awarded the contract to perform the study and prepare this report to:

The Canadian Public Affairs Consulting Group Inc.
201 - 1305 West Georgia Street
Vancouver, B.C.
V6E 3K6
(604) 688-0753

All inquiries concerning the study and report should be directed to the above and marked to the attention of Mr. Charles Kelly (Project Director).

Canadian Public Affairs Consulting has had a broad range of experience in the organization and production of such consulting assignments, especially related to the B.C. and Canadian resource industries, human resource management, business consulting for large and small corporations, and labour and management education.

The firm has established a network of associates and specialists with the philosophy that the best possible specialized expertise should be applied to all assignments. Consequently, the following team of consultants was assembled to lead the study and final report production:

Charles Kelly - PROJECT DIRECTOR
The Canadian Public Affairs Consulting Group
Vancouver, B.C.

Paul Daniell - PROJECT MANAGER
General Manager, Western Canada
Cole & Company Limited
Vancouver, B.C.

Denzil Doyle
Doyletech
Ottawa, Ontario

Francis Moskal
Business & Manufacturing Management Consulting
Mississauga, Ontario

Don Adams
R.J. Clifford & Associates
Vancouver, B.C.

Bob Brown
Cole & Company Limited
Vice President, and
Vancouver Branch Manager
Vancouver, B.C.

Ross McDonald
Wayne-Hill Group Ltd.
Corporate and Finance Consultant
Vancouver, B.C.

B. ii The Executive Advisory Committee for the Study

R. Anderson
Manager, Manufacturing Engineering
A.E.L. MICROTEL LTD.
Burnaby, B.C.

Ed Dodge
Marketing Manager
CANADIAN PACIFIC RAIL
Vancouver, B.C.

Gary Duke
Vice-President
B. C. RESOURCES
Vancouver, B.C.

Tex Enemark
President
MINING ASSOCIATION OF B.C.
Vancouver, B.C.

Gordon English
President
WESTRONIC ENGINEERING SALES
Vancouver, B.C.

Jim Fletcher
VENTURES WEST CAPITAL
Vancouver, B.C.

Tim Kerr
Vice-President
LIGNUM
Vancouver, B.C.

George Killy
Owner
LAKELAND MILLS
Prince George, B.C.

Keith McPherson
Innovation Coordinator
B.C. INNOVATION OFFICE
Vancouver, B.C.

Don Nelson
BURRARD YARROWS
North Vancouver, B.C.

Bill Thompson
President
ELDEVCO
Vancouver, B.C.

Ernie Heim
EBCO INDUSTRIES
Richmond, B.C.

B. iii Interview Form/Questionnaire

(See Next Page)

B.C. TECHNOLOGY CENTRE STUDY
INTERVIEW FORM/QUESTIONNAIRE

1130 - 1176 West Georgia Street
Vancouver, B.C. V6E 4A2
(604) 688-0753

Company: _____ Contact: _____

Address: _____ Title: _____

_____ Phone: _____

I. INDUSTRY, SIZE AND ORGANIZATION

1) Please indicate the general nature of your business:

_____	Food & Beverage	_____	Metal Fabricating
_____	Tobacco Products	_____	Machinery
_____	Rubber & Plastics Products	_____	Transportation Equipment
_____	Leather Industries	_____	Electrical Products
_____	Textile Industries	_____	Non-Metallic Mineral Products
_____	Knitting Mills	_____	Petroleum & Coal Products
_____	Clothing Industries	_____	Chemicals & Chemical Products
_____	Wood Industries	_____	Miscellaneous Manufacturing
_____	Furniture & Fixtures	_____	Non-Metallic Mining
_____	Paper & Allied Products	_____	Metallic Mining
_____	Printing, Publishing & Allied	_____	Construction
_____	Primary Metal Industries	_____	Other, please specify_____
			_____

2) Please indicate the general ownership structure of your firm: (check one)

Public _____
Private: _____ Canadian
_____ Foreign
_____ Mix

3) Please indicate the general organizational structure which best describes your company: (check one)

Local _____
National/Domestic _____ Head Office Location: _____
International _____

4) Please indicate your company size in terms of annual sales: (check one)

	Local Organization	Total Corporate
under $500 thousand.....	_____	_____
$500 thousand - $1 million	_____	_____
$1 million - $2.5 million	_____	_____
$2.5 million - $5 million	_____	_____
$5 million - $7.5 million	_____	_____
$7.5 million - $10 million	_____	_____
$10 million - $25 million	_____	_____
$25 million - $50 million	_____	_____
$50 million - $100 million	_____	_____
$100 million plus		

5) Please indicate your company size (local organization) in terms of number of employees: (check one)

5 to 19	_____	300 to 499	_____
20 to 49	_____	500 to 999	_____
50 to 99	_____	1000 to 1999	_____
100 to 149	_____	2000 to 2999	_____
150 to 299	_____	3000 or more	_____

6) Which of the following best describes the process/products manufactured by your firm:

a) _____ Continuous or Process Flow c) _____ Custom Build

b) _____ Repetitive Batch Flow d) _____ a mix of these (a-c)

What is the length of your average production cycle?
(i.e., time from initial order to delivery) _____ weeks

7) What % of your product is: _____ Consumed Domestically
_____ Exported

8) Please identify the major markets (by industry) for your products or services.

Forestry	_____	Marine	_____
Mining	_____	Rail	_____
Air Industries	_____	Agriculture	_____

Other (explain) _____

II. CAD/CAM APPLICATIONS IN B.C. TODAY

	Yes	No	Intended To Implement/Or Increase Present Use
1) Are you currently using CAD techniques on a regular basis in your company for:			
(a) Engineering Design and Analysis	____	____	____
(b) Computerized Drafting	____	____	____
If yes, name of supplier(s)	____		
2) Are you currently using a computerized system on a regular basis for:			
(a) Custom Order Processing and Finished Product Delivery	____	____	____
(b) Financial Operations/Control (e.g., bal sheet, income statement, receivbles, payables payroll, etc.)	____	____	____
(c) Process Planning (Bill of Materials)	____	____	____
(d) Master Manufacturing Scheduling and Capacity Planning	____	____	____
(e) Materials Requirements Planning and Requisitioning	____	____	____
(f) Detailed Factory Scheduling (with equipment & labour loading)	____	____	____
(g) Factory Floor Control	____	____	____
(h) Inventory/Stock Control	____	____	____
(i) Quality Control/Customer Service	____	____	____
3) Are you currently using CAM techniques such as:			
(a) Automation of manufacturing process	____	____	____
(b) NC & CNC machine tools	____	____	____
(c) Robotics & flexible automation (material handling)	____	____	____
(d) Inspection and Testing	____	____	____

4) How many people does your firm employ who possess the knowledge and skills necessary to apply commputers to:

a) Business and Manufacturing Information Systems ____

b) Production Process, Machine Inspection and Testing ____

5) Do you have an organization or area set aside within your company for R&D of:	Yes	No
a) Products	____	____
b) Manufacturing Technology	____	____

6) a) Do you do any licensed or piece-work for other O.E.M.'s? _____

b) If "Yes" answered in 2a, what CAD/CAM or other technology do they employ which would be helpful for your firm to have the ability to directly communicate with? (Identify equipment if possible.)

_____

_____

c) In the normal course of your business, are you aware of any other ways in which your firm could benefit from the ability to communicate within the mediums of these technologies (e.g., to receive or distribute material from/to clients for bids, specifications, etc. - identify equipment required if possible.)

_____

_____

III. FOR EXISTING USERS (OF TECHNOGIES IDENTIFIED IN II. ABOVE) ONLY:

1) What were the key factors leading to your usage of these technologies?

_____

_____

2) What were the key constraints to usage and to what degree have you overcome these?

a) Awareness _____

b) Knowledge _____

c) Your own implementation capability _____

d) Outside sourcing of knowledge and implementation capability _____

3) What were your relative business benefits from the employments of these technologies in the areas of:

a) Competitive Positioning (more volume, quality image, delivery)

_____ Modest _____ Significant

b) Profitability (unit costs and margins)

_____ Modest _____ Significant

c) Other comments _____

_____

4) How do you intend to stay abreast of changing technology and will you expand your commitment through:

a) internal growth/expansion of own capabilities? _____

b) outside sourcing? _____

IV. FOR NON-USERS (OF TECHNOLOGIES IDENTIFIED IN II. ABOVE) ONLY

1) Do you feel your own awareness of the benefits of this technology for your business is:
_____ low _____ modest _____ adequate

2) Do you intend to adopt these technologies? Over what time frame?

_____

a) Business & Management Information Systems? _____

b) Production Processes, Machine Inspection & Testing? _____

3) What do you feel the key benefits of this technology would be for your firm?

a) Quality, Delivery & Production Volume _____

b) Profitability (Unit Cost) & Faster Re-Investment _____

V. NEED FOR INFORMATION AND SERVICES

1) Does your company have adequate knowledge concerning these technologies through:

_____ in house development? _____ outside sourcing?

Does your company have adequate IMPLEMENTATION CAPABILITY for these technologies available through:

_____ in house development? _____ outside sourcing?

2) Do you see a need for a CAD/CAM Centre for:

	Yes	No	Est. Budget For Outside Services Per Annum
(a) Stimulating a greater awareness of benefits by arranging: conferences, seminars, trade shows, newsletters, etc.	_____	_____	_____
(b) Personnel training & development/familiarization with various CAD/CAM techniques for identification of opportunities and steps for implementation.	_____	_____	_____
(c) Demonstration of CAD/CAM applicability to Manufacturing and particular operations by providing equipment rentals and personnel to guide in usage.	_____	_____	_____
(d) Information Services with libraries of printed materials, films, audio visual aids, suppliers of equipment and software, R&D organizations, and Consulting Services.	_____	_____	_____
(e) Technical Consulting & Applications Engineering, Feasibility Studies, Cost/Benefit Estimates, and assistance in implementation.	_____	_____	_____
(f) Arranging for R&D projects funded by companies on a co-operative basis.	_____	_____	_____

3) Would you make use of the Technology Centre services at a single concentrated facility? Yes _____ No _____

If yes;

(a) During normal business hours only? Yes _____ No _____

(b) During extended hours? Yes _____ No _____

(c) How many people from your firm would use the facility? _____

(d) How often/with what frequency of use? _____

(e) What is your immediacy of need? _____

4) Would you prefer that the centre be owned/controlled by:

_____ Government
_____ Education Institutions
_____ Private Sector
_____ A mix of these/Co-op (which?)
_____ No preference

Would your preference above result in increase use (and spending) of the centre's facilities? _____

VI. MISCELLANEOUS

1) Do you have any other suggestions concerning a technology centre or services and facilities which should be provided?

_____

_____

_____

2) Any other comments on other users, suppliers, education institutions, governments, etc.

_____

_____

APPENDIX C
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